Local Transportation System and Sustainable Communities:

The Case of Churchill, Canada

by Yufeng Lin

A Thesis submitted to the Faculty of Graduate Studies of The University of Manitoba

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

I.H. Asper School of Business Department of Supply Chain Management

University of Manitoba Winnipeg, Manitoba, Canada

ABSTRACT

With increasing awareness of the potential benefit posed by Arctic shipping, many ports and their surrounding regions have undertaken adaptation planning and proactive actions so as to build a resilient and sustained business. However, ports and other coastal infrastructure along the Arctic shorelines are still extremely scarce (and of poor quality), while professional know-how in the construction, maintenance, and operation of such facilities is in short supply. Indeed, hitherto, much attention has been paid to the 'marine' side of Arctic shipping while the 'land' side has been largely overlooked. An illustrative example is the damage of the only rail line connecting to the town of Churchill, Manitoba, Canada by a major flood in May 2017. This has disrupted land connections to Churchill, curtailing all import and export of cargoes (e.g., wheat) via Hudson Bay and inflicting hardship on residents through a substantial increase of expenditures on food and other commodities, as most supplies relied on aviation throughout much of 2017. Based on an in-depth case study on the port and town of Churchill, MB, Canada, we focus on the overall impressions of Arctic shipping development; the fluctuation of price index; employment structure and rate; the shock to tourism; the place's vulnerabilities to Arctic shipping routes; and the establishment of adaptation and resilience strategies. This study will cause a paradigm shift in the research approach in the study of Arctic and generate vital information on how transportation disruption influences remote community and thus damage intermodal transportation development in the Arctic. Based on the literature review and analysis, this study argues that a paradigm shift in transportation operation, notably from 'go it alone' to 'collaborative' approach involving all major port stakeholders, is urgently needed. Also, the thesis investigates Public-Private-People Partnership (4Ps) under the context of the transportation system, the Churchill railway and the port in Churchill. Based on the balance theory, we investigate the triad state of three sectors involved

in the transportation system: public, private, and people sectors. Simultaneously, we study the tendency of triad state, offering insights into the dynamic relationship among people and public, private sectors.

Keywords: Transportation System, Port, Railway, Sustainable Communities, Arctic Shipping

ACKNOWLEDGEMENTS

I would like to express the deepest gratitude to my advisor Dr. Adolf K.Y. Ng and co-advisor Dr. Paul Larson for their guidance, understanding, encouragement and financial support throughout my master study. Especially Dr. Adolf K.Y. Ng, he steered me in the right direction whenever he thought I needed it. I would not have been able to complete this thesis without his incredible patience and guidance. I express my appreciation to Dr. Changmin Jiang, Dr. Luming Wang and Dr. Gary Stern for having served on my thesis committee. They have been offering valuable suggestions and comments for me to improve the thesis. Again, I appreciate all the guidance and help from my committee members.

As part of the project entitled 'Local Transportation System and Sustainable Communities: The Case of Churchill, Canada,' this thesis is an attempt to draw an overall picture of local transportation system at a global level. My gratitude goes to the participants for their engagement in the interview and help in recruiting their friends to join the research. I would like to deeply thank all participants for their precious time and selfless sharing.

Thanks also go to all the professors who helped me to establish diverse knowledge (in the field of supply chain management, sociology, and economics) and develop research abilities. I would also like to thank Ms. Siobhan Vandekeere, Ms. Ewa Morphy and Ms. Ellen Shi for the great support. Special thanks to my family and friends who are always by my side and support me through this academic exploration.

STATEMENT

Chapter 2 is under the review of SAGE Research Methods Cases. SAGE Research Methods Cases reaches students and early-career researchers at more than 300 institutions worldwide. The case studies they seek are written in a conversational style, to inspire and guide new researchers, so the first person is utilised in this chapter.

Chapter 3 is extracted from our published review paper (A. K. Ng et al., 2018). As a co-author, I am responsible for the parts that I put into my thesis. The other part examines the accessibility of Arctic shipping by reviewing the impact of climate change on sea ice and marine; therefore, I decided to cut this part, which is not related to my thesis.

Chapter 4 Lin, Y., Ng, A. K.&Afenyo, M. (2018) is accepted as a book chapter under the review of Geographies of Maritime Transport, edited by Gordon Wilmsmeier and Jason Monios. Literature review, the case of Churchill and the discussion are my contributions to this book chapter; the introduction part is by Muwuli Afenyo. As the book chapter is still under review and the requirement of a thesis is distinct, some changes have been made to this chapter. For example, a literature review of a sustainable community is added, and the title of this chapter might be different from its title in the book.

Table of Contents

List of Tables

List of Figures

List of Abbreviation

4Ps	Public-private-people partnership
AR5	Fifth Assessment Report
CNR	Canadian Northern Railway
CPA	Canada Port Authorities
CWB	Canadian Wheat Board
IPCC	Intergovernmental Panel on Climate Change
IV	Independent Variable
NNC	Nutrition North Canada
NSR	Northern Sea Route
NWP	Northwest Passage
SCR	Suez Canal Route
SLR	Sea Level Rise
TSR	Trans-Polar Sea Route

CHAPTER 1 INTRODUCTION

The issue of Arctic shipping has become a prominent topic in both the research community and people's daily life. With the climate change happening in the Arctic, people are looking for shorter sea routes connecting Europe via the eastern North American coast to the eastern North American coast to Asia (Lasserre, 2011). The current sailing distance between Rotterdam and Yokohama is 11,200 nautical miles, while the new shortcut sailing route is measured to 6,500 nautical miles. Similarly, the current sailing distance between Seattle and Rot is 11,200 nautical miles, while the new shortcut sailing route is measured to 6,500 nautical miles. Considering canal fees, fuels cost and other factors influencing freight rates, Arctic shipping routes were able to cut the cost of a single voyage by a large container ship from about $17.5 million to $14 million (Borgerson, 2014).

However, the feasibility of Arctic shipping is still under discussion(A. K. Ng, Andrews, Babb, Lin, & Becker, 2018). The physical accessibility, social-economic feasibility, and the scarcity of quality infrastructures are all calling further research. To understand or even solve the problem of the quality supporting infrastructures like railway and port, an illustrative example of transportation disruption in North Manitoba, Canada, was studied. Churchill Railway was washed out by a sever flood in May 2017, resulting in hardship on residents physically and mentally.

To raise the awareness of stakeholders in communities, entrepreneurs, and policymakers, a study of the sustainable transportation system in sustainability initiatives and the development of sustainable communities needs to be addressed. Given that the time for building sustainable communities to take effect can be significant, it is crucial to implement a sustainable transportation system effectively in the foreseeable future. Although the importance of transport and connectivity

are mentioned in a few studies, they tended to be forgotten or set aside. E. Innes and Booher (2000) reviewed the practice of indicator development and its use for sustainable communities. They claim a city function like a living organism, which is a complex adaptive system, proposing a strategy for community indicators. Marsden (2008) brings together interdisciplinary theoretical debates and empirical cases from an international perspective which explore the possible development of a sustainable community. However, the role of the transportation system and how the transportation system can contribute to sustainable communities is not clear.

Moreover, with the opening of the Arctic shipping and emerging tourism industries, the Port of Churchill gains more than is used to be. However, the ownership conflict left the port of Churchill and Churchill railway fundamentally closed and unrepaired. To achieve collaboration among stakeholders, some researchers sought to overcome these barriers from the perspective of Public-Private-People Partnership (4Ps) (Buse & Walt, 2000; Klijn & Teisman, 2013; Perjo, Fredricsson, & Costa, 2016). A systematic discussion of how to achieve stakeholder collaboration is still lacking. To fill the research gap, this thesis investigates the triad state of 4Ps and how interest conflict can be surpassed to advance stakeholder collaboration.

To tackle the contemporary issue of involving stakeholders in the development of a local transportation system for involving stakeholders, the thesis addresses the following primary research question: how does the local transportation system influence the development of a sustainable community? A better understanding is developed by answering the following secondary research questions are developed as 1) how does the local transportation system influence the regional transportation system 2) How the collaboration among different stakeholders can be achieved by Public-Private-People partnerships? The first secondary research question is answered by interview data, which aims to 1) provide a holistic view of local

community's perceptions on the influence of a local transportation system, and 2) prove that sustainable transportation is a critical factor of sustainable communities. The latter secondary research question is addressed by delving deep into the current phenomenon from an institutional angle with theoretical analysis and a case study.

The overall structure of the study takes the form of five chapters. After this introductory chapter, Chapter 2 consists of the literature review and lays out the feasibility of Arctic shipping, bringing out the question of poor-quality infrastructure on the land. Chapter 3 presents and discusses the influence of transportation disruption on a remote community, Churchill, Canada, while Chapter 4 focus on 4Ps that has emerged from the local transportation system in Churchill. Finally, discussion, limitations, future research directions and implementations can be found in Chapter 5.

CHAPTER 2 METHODOLOGIES

The nature of this topic required qualitative and unpublished information. Interviews are widely employed in case studies, as it enables researchers to communicate with the 'right' people and obtain 'inside' knowledge of their operations and experiences. Also, information acquisition involved numerous unpublished, written oral, materials, understanding that multiple stakeholders are involved in the Churchill railway, and their development and livelihood are deeply connected to the railway. Yin (2009) defines the case study "as an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not evident." For the question of when to use a case study, Yin(2009) proposes three conditions: the type of research question posed, the extent of control an investigator has over actual behavioral event and degree of focus on contemporary as opposed to historical events. The chosen method is related to the research question. The more that the research questions seek to explain some present phenomenon (e.g., "how" or "why" a phenomenon exists), the more that the case study method is applicable. Also, when the research question does not require control of behavioral events, a case study would be possible. Under these circumstances, a case study applies to our research.

Case studies have a various advantage. First, the examination of the data is mostly conducted within the context of its uses (Zainal, 2007), that is, within the circumstance where the activity occurs. Second, cases studies allow for both quantitative and qualitative analyses with intrinsic, instrumental and collective approaches. Most importantly, case studies enable researchers to code data at the micro levels (Zainal, 2007). In other words, it helps researchers to

investigate the data in the real-life environment, explaining the real-life situations which may not be answered through experimental or survey research.

Case studies are often accused of lack of rigor, and the bias the researcher have on the data. Also, their scientific generalization is criticised due to the small sample size. Being too time-consuming and difficult to conduct is also an issue of concern.

Based on Gray's (2004) work, my research was conducted in three stages. The first stage is involving using raw case data including all the information about an organization, person(s) or event. We tried to develop a theory, select cases and design and pilot research tools, protocols and field procedures. Like any other scientific research, a case study is supposed to start with a theoretically and practically interesting research question (Bhatttacherjee, 2012). Since the primary mode of data collection in the case study is an interview, we thought about questions whether they should be open-ended or closed-ended or a combination of both. Plus, to fully understand Churchill, documentation and direct observations were utilized to support interview data. Based on our access and time, we decided to conduct a single case study. Second, we created a case study database that could be used to evaluate the data to improve the reliability of the study (Gray, 2004). A case study database also helps researchers to check, follow and analyze data. The final step is to write the case study narrative. It is conceptually linked back to the case study records and raw case data. Data analysis may follow or overlap with data collection. Techniques such as open coding, axial coding, and selective coding may be utilized to derive a chain of evidence and inferences (Bhatttacherjee, 2012). Open coding is utilized as our analyzing method. Based on emergent concepts and themes that are generalizable across cases, tentative hypotheses are constructed. These hypotheses were also compared with observed evidence or official documents to see if they match.

Hence, following the logic of inductive reasoning, we triangulated data collection with documentary reviews (e.g., government documents, official statistical yearbooks, archival records, or company internal reports). Also, semi-structured, in-depth interviews with 20 relevant personnel were conducted in Churchill, between September 2017 and October 2017. The choice of interviewees followed a snowball sampling technique. The selection of participants started with researchers and staff in the Churchill Northern Studies Centre (CNSC). They were asked if they could recommend potential interviewees that they deemed the most relevant to the research. This technique helps to include the 'right' people to share their knowledge, perceptions, and experience.

Consequently, data from a limited number of interviews is regarded as enough and reliable. The interviewees represented nearly all those who are influenced by the railway. The process of verifying the appropriate interviewees will be complete when saturation has been reached. The interview questions were closely knitted to the project's objectives. They include but also not limited to questions like the overall impressions of Arctic shipping development; the fluctuation of price index; employment structure and rate; the shock to tourism; vulnerabilities to Arctic shipping routes; and the establishment of adaptation and resilience strategies towards transportation disruption (see Appendix A for all interview questions).

Power dynamics

Power dynamics refers to the perceived authority of one person in the interaction.

Although my research persona was that of a researcher rather than a student, I was nonetheless aware during all stages of the data collection that I was predominantly interviewing some senior executives. As such, subtle and unspoken power dynamics often existed between me

as the perceived younger/junior/student researcher wanting something from the respondent and the predominantly older/senior/manager executive agreeing to give me their time.

Power dynamics can also lead to a more senior person attempting to take over an interview and determine its agenda. To avoid this, there were some instances during the interviews when I played up to the authority these individuals expected, by allowing them to share unsolicited information to encourage and build mutual respect. At key points, I then brought the interview back on track to ensure that the aims of the study were met.

Ethical Consideration

It took me around four months to go through the ethical process since my sample would somehow include indigenous people. For example, when we received eight questions from the feedback, half of them would be related to indigenous ethical issues. This experience did help me prepared for the coming challenge and personally, would benefit researchers in better ethical consideration.

To go through the ethical procedure, community engagement plan is required because the indigenous community is involved. In the community engagement plan, we did a review of events and activities that we would do to conduct my research. For example, we considered Churchill Northern Studies Center (https://www.churchillscience.ca/about/the-centre.cfm) considered an access to local resources. They provide funding and volunteer opportunities for researchers. We did recruit some participants the through the studies center. Most importantly, the big part of an engagement plan is timely feedback and the next step, namely the contribution to the local community.

We provided opportunities to participants after the interview. They left us feedback on the form or talk to us about this program if they feel confused about or interested in the program. Further inquiry about the program was offered to participants.

If they showed interest in our program, they could leave their email address. All interviewees will be provided a brief, non-technical document summarizing the major findings from the project. With the data from Churchill, we also worked with a group of students to hold a fundraising for Churchill, and we donated all the money to an organization in Churchill.

Also, a presentation of the paper will be arranged in Churchill after the accomplishment of a thesis. Because of limited time and funding, the presentation may be held through Skype. We will try to contact the local newspaper and get our summary of our research published to share our funding with the local community. In addition, we would like to ask participants whether they have ideas of disseminating the knowledge to the community. If any suggestions are proposed, and they are practical, we would like to take them into practice, spreading the knowledge to the general indigenous community.

Gaining Access to a Sample

A key consideration in this research project was accessing the people who would ultimately participate in the studies. Access was both planned and opportunistic. Gaining access to a decent sample size can be challenging for Master candidates, mainly when one is a novice or inexperienced player, or perceived as a student. In our project, because the success of the study was dependent upon gaining accessing to residents in Churchill, a remote community, thereby requiring initial connection before my trip to Churchill. We recognized early on that we needed to

find an edge to get a foot in the door and have key contacts in the town who would, at the least, listen to our pitch before deciding whether to participate.

At the very first beginning, we reached to the vice president that I met in a conference, their company owns a superstore in Churchill. With his help, we built a connection with the manager of the Northern store in Churchill. Also, we contacted University of Manitoba Indigenous Students' Association (UMISA), and the assistant there gave us the contact of their vice president, who originally from Churchill. Later when I met her, she gave me her advice on the topic and gave a list of people that we could ask. It is a small town with only 900 people so basically, everyone knows each other. With her agreement, we took her as our referee when we met people in Churchill. It helped us reach to many people and some people we may never get a chance to interview if we would not have known her.

In addition, when we were in Churchill, we spent time walking around the town and getting to know residents. Again, this is a small town. Eeveryone knows each other. With the reference of someone they know, most of them agree to participate in the research. Also, we tried to recruit people on Facebook by posting on the online board and messaging some people in the group, and some respondents are from there. We also met some people in the museum or restaurant. All these result in a decent sample size when we finished our field trip in Churchill.

After that, with what we learned from the Churchill, we started to share the information we got from the participant, which brings us more participants on the way. Things are shaping up themselves when we proactively try to achieve it. In this process, we used snowball technique to recruit participants, but some methods like using social media are also utilized. The point is, when we try to access our sample, we could mix different methods to increase the number of participants we may get.

Table 1 Details of interviewees

Name	Position
A	Store Manager
B	Store Manager
C	Government staff
D	Curator
E	Store Manager
F	Store staff
G	Train office staff
H	Lawyer
I	Nurse
J	Truck Driver
K	Port Worker
L	Store Owner
M	Teacher
N	Port Worker
O	Park Canada Stuff
P	Professor
Q	Store staff
R	Researcher
S	Researcher
T	Stuff in Research Centre

Participants included port workers, store managers, staff, and curator. They were chosen for the interviews not only because of their residence in Churchill (number of years staying in Churchill) but also because of their experience and opinion emerged from the railway disruption.

All the discussion questions were designed according to interviewees' backgrounds so as to obtain maximum relevant information. Questions involved the influence of railway disruption including (but not restricted to): the overall impressions of Arctic shipping development; the

fluctuation of price index; employment structure and rate; the shock to tourism; the dependence of the local economy on the railway; and the establishment of adaptation and resilience strategies。

The procedure and difficulty of open coding

The first step is that we try to go through the transcript, understanding the whole story or the theme of this transcript and mark some important information like keywords. Some notes are written down to remind me of the structure of the transcript. After finishing the first reading, I start to create my codes. Coofey and Atkinson(1996) suggested that conceptual codes can be a more grounded or descriptive approach, also the first step, to coding, so we try to create codes at a greater level of abstraction from the data, such as "price", "service", "employment" etc.. Besides, some codes are derived from sources outside the transcript, such as "building environment", "economy", "social psychology" etc.. we have created 25 codes at the beginning, but when we went through the transcript again, we decide on a 'final' list of codes that will be applied to my analysis. The process is more like a back and forward process because it inevitably involves the reading and re-reading of data and refining and modifying codes(Coffey & Atkinson, 1996).

Once coding is achieved, we tried to explore the general meaning. We divided them into five categories, which answered my research questions related to the transcript: the influence of transportation disruption on building a sustainable community. Some codes are deleted because they are redundant or repetitive. Many analyses of qualitative data start with an identified concept, construct or themes, while the topic of this transcript is derived from the process of coding data (Coffey & Atkinson, 1996). We need to break down the data and integrate them again, retrieving the most significant bits of the data. Coding can be considered as an approach to generate a concept

from the data. In addition, coding is not a substitute for analysis(Coffey & Atkinson, 1996). All the codes we create are meaningless when we read them respectively, and the analysis of each code is not rounded, either. This coding process enables me to realize that coding is one powerful tool to analyze data, but it is not the analysis itself.

Reflexivity is linked to our ambivalence about our role in the research (Mauthner & Doucet, 2003). As 'our subjectivity' influences how we interpret other's presence, being reflexive about how we interpret our data, our role in the analytics process and the pre-conceived ideas and assumptions we bring to our analysis is critical to our research (Altheide & Johnson, 1994).

One problem of coding is that when we chop them up into separately coded segments, we are in danger of losing the sense that they are accounts (Coffey & Atkinson, 1996). Trying to integrate codes, we were confused by the linking between codes occasionally because some codes have already lost partial information when they are not couched in the story. In the story, a participant expressed her strong frustration with the situation as the price of the commodity has skyrocketed. However, the code, "frustration", only captured what the participant is concern about instead of the reason why she felt like that. She has a daughter as a single mother with four kids, and things have been taught for this family. We could not deny the fact that her worry about her daughter could result in such strong negative emotion instead of the solely increasing the price of groceries. Losing part of the information or the meaning makes it difficult for us to explain the whole story.

Another problem, the biggest challenge, is the voice of the participant. The problem shows up in the integration and interpretation of codes. Reading the interview transcript revokes our empathy with the participants. Unconsciously, we interpret codes with a strong focus on getting the railway back. For instance, most of the participants complained about Omnitrax taking money

but doing minimum maintenance to barely keep the railway running. Some of them also stressed that the government is doing nothing, and they are abandoned by their own country. All these words infect us with strong negative emotions, finding myself deeply hoping for the return of the railway and best for the local community. However, this thought might eliminate other possibilities emerged from the disruption. How about building a new road instead of repairing the old and dysfunctional railway? We do emphasize the importance of the railway, but it should not be the only option. To be objective during analysis demands that we should be reflexive and neutral at the same time. I think it is unavoidable that we are influenced by participants' perception and attitude as we need to do an in-depth research so sticking to our neutral position can be a challenge.

Resonance

Resonance refers to a study's ability to meaningfully reverberate and affect an audience (Tracy, 2010). When we tried to construct the paper, we took advantage of some narrative materials, helping readers to understand the perspective of residents in Churchill, an isolated or so-called abandoned area. In this way, readers can have their ideas when they go through the study instead of receiving information edited by the authors.

Resonance mainly includes aesthetic merit and transferability, and naturalistic generalizations, so the evaluation of a study will be based on these two standards. Aesthetic merit refers to the text presented in a beautiful, evocative and artistic way (Tracy, 2010). We tried to intertwine the participants' voice with my content. According to a participant, "will Churchill have extra money for new port or better road? I do not know…It is more about the security. It is going to generate jobs, investment and eventually, may generate some sort of service to Churchill but most importantly, it is going to secure your 'say' in that transportation and our community". The

sentence is simple but sincere, revoking the compassion of readers. Consequently, the text is written in a catching way for its combination of two voices – the authors and the participant.

Transferability and naturalistic generalizations refer to a study's potential to be meaningful across a variety of context or circumstances (Tracy, 2010). Qualitative research engages in-depth studies that produce historically and culturally situated knowledge. Transferability is achieved when readers fully understand the severe consequence of transportation disruption. Narrative material and personal experience enhance the transferability by offering voice and stories from real life. Also, generalization is achieved when the authors link the importance and resilience of the transportation system in Churchill to those in other different remote areas. Within the case, generalization arises from shifting small instances to a larger frame.

CHAPTER 3 IMPLICATIONS OF CLIMATE CHANGE FOR SHIPPING: OPENING THE ARCTIC SEAS

3.1 Adaptation to climate change and a potential opportunity

Climate change presents many impacts for human activities, including shipping. With more than 80% of globally traded cargo carried by ships (Ng, A.K.Y. and Liu, 2014), shipping and the maritime industry plays an important role in the well-being of global and regional economies. A considerable volume of research investigates the negative impacts posed by climate change on transportation infrastructures. For example, the book by Ng *et al.* (Ng, A.K.Y., Becker, A., Cahoon, S., Chen, S.L., Earl, P. and Yang, 2016) contains numerous cases on how climate change affects the operation of ports located on four continents, and how port stakeholders attempt to adapt to such challenges.

Climate change impacts will likely have both positive and negative elements. In fact, some societies may benefit from the development and implementation of effective adaptation strategies and solutions (Ng, A.K.Y., Becker, A., Cahoon, S., Chen, S.L., Earl, P. and Yang, 2016). The United Nations Framework Convention on Climate Change supports this view and defines adaptation to climate change as follows:

> '…Adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts...Changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.' (UNFCCC, 2014)

In this regard, Arctic shipping provides an example of potential climate-change related costs and benefits. Reduced ice cover may present opportunities as certain Arctic marine routes

that have historically been covered by sea ice become navigable for part of the year. For example, a Russian tanker sailed through the Arctic without icebreaker assistance for the first time in August 2017 (Barkham, 2017). Although Larsen (Larsen, 2016) argues that the economic feasibility of Arctic shipping is underexplored, a growing body of literature is gradually filling the gap.

It is not yet clear how climate change and Arctic shipping will impact the environment and indigenous people of the north, but recent research has pointed to a number of significant challenges. Conversely, Arctic "thawing" may also present certain positive implications, such as shorter routes (thus lower transportation costs) and increased accessibility to known resource deposits. If so it could trigger another phase of evolution in the global shipping industry that is characterized by shorter shipping distances through Arctic waters instead of conventional navigation routes *via* the major canals (e.g., Suez Canal, Panama Canal). This is especially true as the intense competitive landscape pressures cost-sensitive ship operators to reduce costs (and price) even further.

There are currently three main trans-Arctic navigation options: The Northern Sea Route (NSR), the Northwest Passage (NWP), and the Trans-Polar Sea Route (TSR). The feasibility and economic viability of these Arctic routes are still under intense debate. Although some research has been undertaken (Cheng & Lee, 2011; Roh, 2011; Xu, Yin, Jia, Jin, & Ouyang, 2011), many studies have only addressed the potential cost savings of using Arctic routes compared to existing trans-continental shipping networks (e.g., between Asia and North America). In fact, many important aspects of Arctic shipping remain under-examined. For example, despite the potential benefits, some still argue there is a lack of real interest in Arctic shipping (e.g., according to Pierre and Olivier (Pierre, C. and Olivier, 2015), only 53 transits *via* the Arctic were recorded in 2013) and that shipping stakeholders have yet to treat the Arctic routes as serious alternatives. Also, the

opening of the Arctic waters will pose various environmental, social, and cultural impacts to surrounding regions, including a heightened risk of maritime accidents and environmental harm due to the lack of infrastructural support. Given the complex nature of the Arctic, what is the right approach for further research?

This chapter examines Arctic shipping through a collaborative effort between researchers from different disciplines. Section 2 discusses the feasibility of shipping in the Arctic marine environment from the physical perspective. It examines the impact of climate change on sea ice and marine weather and considers the resultant consequences for Arctic shipping accessibility. Section 3 discusses the challenges of Arctic shipping from the socio-economic and environmental perspective. It reviews the major research investigating the economic feasibility of diverting ships from conventional shipping routes to the Arctic routes. Also, it reviews the attitudes of shipping stakeholders, as well as the social and other considerations that affect the prospect of Arctic shipping. Finally, section 4 concludes the paper and identifies the major gaps that need to be addressed in future research.

3.2 Feasibility of Arctic shipping: socio-economic perspective

3.2.1 Economic viability

Recent research into the NSR illustrates the economic potential in Trans-Arctic shipping routes: the NSR will reduce travel distance by approximately 40% (Liu, M., Kronbak, 2010; Schøyen, H., Bråthen, 2011), contributing to a saving of 3 - 5% in fuel costs (Xu et al., 2011) when compared to the conventional Suez Canal Route (SCR). However, internal and external factors have brought in to question the viability of Arctic shipping. The research findings in the existing

literature are somewhat contradictory. For instance, Lasserre (Lasserre, 2014) found that among the 26 selected previous studies on this topic, 13 of them suggest that Arctic routes can be profitable for commercial shipping, six are ambivalent or do not take a position, and seven conclude that conditions are too difficult to be profitable. In fact, profitability can be observed differently even between two similar routes going from/to similar origin/destination ports due to a variety of cost factors (Somanathan, S., Flynn, P. C., Szymanski, 2007).

Although some works on the economic feasibility of Arctic shipping routes have been conducted in the past decade (Kitagawa, 2008; Lasserre, 2014), they usually come with serious limitations. First, many only include distance and fuel costs as factors for consideration. In reality, fuel consumption may not be the key component that determines the viability of Arctic shipping. Other factors, such as operational obstacles and the need for new vessel designs, may increase costs. Moreover, uncertainties in the future of Arctic regions cannot be neglected. Uncertainty may arise from various areas: climate and weather, market, policies and regulations, culture, and local communities. Insufficient historical data makes it more difficult to obtain adequate and robust predictions of the Arctic conditions, not helped by the poor infrastructural support and a lack of navigating experience along the Arctic routes. This implies a higher risk of accidents and pollution, with the accident of the Clipper Adventurer in 2010 near Kuguluktuk in the Canadian Arctic as an illustrative example. All these factors contribute to the lack of competitiveness of Arctic routes against the traditional ones (e.g., SCR).

Researchers identify some attributes that make shipping using the Arctic routes less attractive to shippers. For instance, Schøyen and Bråthen (Schøyen, H. Bråthen, 2011) highlight seasonality as the major disadvantage of Arctic shipping. As discussed in section 2, the Arctic open-water shipping season typically lasts for 4-5 months between July/August and November

(Faury, O., Cariou, 2016). The lack of reliability (with reference to accessibility) is likely to result in much higher insurance fees, and even that is under the assumption that marine insurers are willing to insure in the first place (Schøyen, H., Bråthen, 2011). In addition, high icebreaking fees (Kiiski, T., Solakivi, T., Töyli, J. and Ojala, 2016; Liu, M., Kronbak, 2010), poor quality or non-existent infrastructural support (Xu et al., 2011), constraints on sailing speed (Pierre, C. and Olivier, 2015), and investments on ships to adapt to the unique shipping environment (Kiiski, T., Solakivi, T., Töyli, J. and Ojala, 2016) all contribute to higher costs and uncertainty. More investments on vessels, supporting infrastructures, and specially trained seafarers and workers would further heighten the costs of the Arctic routes.

Zhang *et al.* (Zhang, Y., Meng, Q., Zhang, 2016) suggest that while the Arctic shipping routes may not be a feasible alternative for container shipping, it is more appealing to small- and medium-sized tankers. Zhao *et al.* (Zhao, H., Hu, H., Lin, 2016) support this view in their study on China-EU shipping, suggesting the Arctic as a supplementary shipping alternative. This is further supported by the results derived from the latest traffic data, where Zhang *et al.* (Meng, Q., Zhang, Y. and Xu, 2016) found that liquid, bulk, and general cargo carriers are more likely to operate *via* the Arctic routes. From the economic perspective, the prospects of Arctic shipping are still up for debate.

3.2.2 The attitudes of shipping stakeholders

Ship owners take operational risk and reliability seriously when they evaluate the value of Arctic shipping. Lasserre and Pelletier (Lasserre, F., Pelletier, 2011) analyzed the perceptions of ship owners on shipping *via* the Arctic and found that due to the fierce competition within the global shipping industry, ship owners have few incentives to strategically adopt Arctic shipping,

especially for container shipping. In later research, they reach the same conclusion: ship owners perceive shipping *via* the Arctic routes as risky and melting sea ice is not sufficient to promote Arctic shipping on a large scale (Lasserre, F., Beveridge, L., Fournier, M., Têtu, P. L., Huang, 2016). These results are in line with other similar research. For instance, through a stated-preference survey, Benedyk and Peeta (Benedyk, I.V., Peeta, 2016) found that freight transportation operators show little interest in Arctic shipping. Even if a shipping firm wants to strategically invest in Arctic shipping, it would need to pay substantial attention to its internal components, notably financial capacity and market competitiveness (Lee & Kim, 2015). That said, others suggest that most Arctic shipping stakeholders are attracted by the opportunity of extracting energy and natural resources (Lasserre, F., Beveridge, L., Fournier, M., Têtu, P. L., Huang, 2016; Lee & Kim, 2015) rather than exploiting sea routes. This so-called 'Arctic exploitation' consists of diversified economic activities, such as fishing, oil and gas extraction, and tourism (e.g., cruise) (Jabour, 2014; Kaiser, B.A., Fernandez, L.M. and Vestergaard, 2016).

3.2.3 Environmental, Social, and other considerations

The impacts of intensified shipping in Arctic waters on regional development should not be overlooked. In this regard, Ng and Song (& S. Ng, 2010) argue that most negative impacts posed by shipping are not due to large scale accidents (e.g., major oil spills) but routine operations, such as bilge discharge or other types of day-to-day pollution. Though still not fully understood, research suggests that oil spills in the Arctic may present an even greater environmental challenge than they do in warmer waters due to reduced rates of weathering and transport of oil through ice-covered waters (Afenyo, M.; Veitch, B.; Khan, 2016). Both trans-Arctic voyages and destination shipping within the Arctic will likely result in new biological invasions to ecosystems through

ballast water exchange and organisms transferred on the hulls of ships (Miller, A. W.; Ruiz, 2014). Noise associated with increased shipping may also affect migration routes and marine mammal behavior as much as 52km away from tankers (Halliday, W., Insley, S., Hilliard, R., De Jong, T., Pine, 2017).

The Polar Code (International Maritime Organization., 2015) stresses that ensuring stricter practice in Polar waters is warranted as an essential and positive development for Arctic shipping. Shipping and resource extraction impacts on wildlife (e.g., caribou and seals) can, in turn, present major challenges to the indigenous peoples whose traditional livelihoods depend on these resources (Cameron, 2012). One of the main discourses on Northern geopolitics is that there is a 'race' for natural resources as well as emerging regional conflicts based upon the competing assertions of state sovereignty (Borgerson, 2014). In general, indigenous rights slow the development of the resource economy because they disturb the spatial characteristics of capitalism: accessibility, transparency, and homogeneity (Powell, 2014). With intensified shipping in the Arctic, risks to local autonomy and sovereignty may increase as extra-territorial actors, such as China, get involved. Such threats led to the polar Inuit Declaration of Arctic Sovereignty in 2009, which explicitly states the rights of the Inuit with respect to their natural wealth and resources (Eninger, C.; Zambetakis, 2009). Hence, opening the Arctic seas may trigger competing conflicts between global supply chains and local interests.

To minimize such impacts on social and environmental systems, shipping *via* the Arctic needs to be supported by quality infrastructure (e.g., ports, navigational aids, support vessels, and rescue systems) and know-how to ensure the safety of these shipping routes, as well as the environments they may impact. Military installations in the Russian Arctic and large port projects (e.g. Yamal) are now under construction, while the Canadian port in Churchill curtails all import

and export of cargoes (e.g., wheat) via Hudson Bay and inflicts hardship on local residents through a substantial increase of expenditures on food and other commodities for the absence of basic infrastructure (e.g., Train). In the Eastern Arctic, along the NSR, Russia has been building military installations and large ports (e.g. Yamal), whereas in the Western Arctic, along the NWP, there is very little infrastructure. Canada has committed to building a port in Iqaluit and developing the Nanisivik Port on northern Baffin Bay, but with little infrastructure beyond this local communities and the limited seasonal presence of the Canadian Coast Guard will be relied upon heavily. As noted by Xu *et al.* (Xu et al., 2011), ports and other coastal infrastructure along the Arctic shorelines are still extremely scarce (and of poor quality), while professional know-how in the construction, maintenance, and operation of such facilities is in short supply. Indeed, hitherto, much attention has been paid to the 'marine' side of Arctic shipping while the 'land' side has been largely overlooked. An illustrative example is the damage of the only rail line connecting to the town of Churchill, Manitoba, Canada by a major flood in May 2017 (Figure 11). This has disrupted rail services (and all land connections) to Churchill, curtailing all import and export of cargoes (e.g., wheat) *via* Hudson Bay and inflicting hardship on local residents through a substantial increase of expenditures on food and other commodities, as most supplies relied on aviation throughout much of 2017. Finally, the use of Arctic routes implies competition between different shipping alternatives. This may intensify inter-port competition, not necessarily just ports in the Arctic but also those in the major economic powerhouses (e.g., East Asia, Western Europe, North America).

3.3 Discussion

The paper reviews the implications of climate change for Arctic shipping accessibility and examines the feasibility of Arctic routes as realistic alternatives to current southern routes. There are many challenges to overcome if responsible Arctic shipping is to be achieved, including: physical constraints, questionable economic feasibility, indifferent (or negative) attitudes of shipping stakeholders, a serious scarcity of quality infrastructures and know-how that risks safety and sustainability, the uncertain and likely powerful impact of Arctic shipping on the indigenous population and Arctic ecosystems, and the need to improve a framework that can effectively govern and facilitate sustainable shipping in the Arctic, to name but a few. We found that the complex nature of Arctic shipping has accentuated the (arguably) excessive emphasis on financial assessments, notably in relation to how the Arctic can benefit trade and global supply chains. The social, environmental, and local impacts posed by increasing shipping in the Arctic are often pushed to the backseat. Further research on Arctic shipping must address this deficiency.

The Arctic is developing quickly, and its potential must not be ignored. The opening of Arctic seas and effective adaptation to climate change can generate opportunities to the local, national, and global systems. Further research should develop effective methods and tools that can accurately assess the costs and benefits of opening the Arctic waters, especially the socio-economic and environmental impacts of increased shipping activities. For example, the NSR Administration requires an application to be submitted to travel on the NSR 15-120 days before entry into Russian waters (CHNL Information Office, n.d.). Melia *et al.*(Melia, N., Haines, K., Hawkins, E., Day, 2017) are the first to explore seasonal forecasts for Arctic shipping, finding that skillful predictions are possible on the seasonal timescale. However, this kind of study is generally rare in the climate/meteorology community. Different scenarios for end-users and different

scenarios for the socio-economic costs generated by different types of shipping activities (e.g., cruise ships, bunker ships) could be gauged through scenario analysis to international trade, as well as regional and local societies. For instance, data on the cost of oil spills in the Arctic corridors, the costs of clean-up infrastructures, and potential compensation to the local (especially indigenous) communities, to name a few, can facilitate marine insurers to establish a framework that can effectively dictate insurance premiums to ship operators interested in operating ships through the Arctic routes. Also, this enables policymakers from different agencies (e.g., Transport Canada, Manitoba Infrastructure, Coast Guards, etc.) to design better regulatory frameworks dedicated for specific Arctic corridors (e.g., areas that are deemed vulnerable will be prohibited from being assigned as shipping corridors). This contributes to the establishment of multiple 'sustainable' Arctic navigation corridors and catalyzes the formation of sustainable shipping networks. The complex nature requires future research to gather collective knowledge from different disciplines, and (currently very scarce) close collaboration between natural and social scientists in addressing this topic is especially important. We hope that this collaborative work between researchers from the natural and social sciences will help initiate this process.

CHAPTER 4: THE INFLUENCE OF TRANSPORT DISRUPTION ON AN ARCTIC COMMUNITY

4.1 Introduction

Shipping activities in the Arctic has increased lately (Afenyo, M.; Veitch, B.; Khan, 2016; A. K. Ng et al., 2018; Ostreng, Eger, Fløistad, Jørgensen-Dahl, A. Lothe, & Mejlænder-Larsen, M. Wergeland, 2013). This is made possible by the rapid melting of the ice at an unprecedented level (A. K. Ng et al., 2018; Ostreng et al., 2013). The phenomena has prompted governments of Arctic countries to develop the shipping routes further in order to make them safe and viable commercially (Ostreng et al., 2013). Many studies have reviewed the feasibility of the new Arctic sea route: The northern sea route and the Northwest Passage(A. K. Ng et al., 2018; Ostreng et al., 2013). The authors concluded that they are viable alternatives to the conventional shipping routes like the Suez Canal. Most works have gone further to compare these new routes and the old ones and agreed that in terms of distance, the new ones are shorter (Lasserre, 2011; Liu, M., Kronbak, 2010; Ostreng et al., 2013; Schøyen, H. Bråthen, 2011).

However, scholars have not reached a consensus on the cost implications regarding insurance, escorts, emergency response and implication of potential oil spill. When these are considered the comparison may not be straight forward (Ostreng et al., 2013).

However, of the new sea routes, the Northern Sea Route has experienced the most traffic. This is due to several reasons. These include i) the rate of ice melt and for that matter, the quantity of ice along the routes are less compared to the Northwest passage, ii) Russia, the country sovereign over this area has invested a lot in terms of icebreakers, infrastructure and other necessary logistics to make it safe and navigable. This, therefore, creates confidence for the ship

owners and operators to use this route iii) the routes are better defined compared to those in the Canadian side (Northwest Passage) (Ostreng et al., 2013).

These reasons mean that the Northwest Passage needs much investment before it is ready to take advantage of the potential positive effect of climate change. For an area that contains approximately 30% of the world's hydrocarbon deposits as well as other precious minerals (Lasserre, 2011; Lee & Kim, 2015). It is also very strategic for the future energy security and wealth of the individual countries (Ostreng et al., 2013).

Knowing how important the Arctic and for that matter, the Northwest Passage is likely to become, the Canadian government has stepped up work in this region. Though the sovereignty of the Northwest passage is still a matter of discussion between Canada and the United States (Ostreng et al., 2013), a well-developed route with good infrastructure will not only be beneficial to both countries but the world at large. This is because shipping will become faster, jobs will be created, and scientific research will also be enhanced (Lasserre, 2011; Ostreng et al., 2013).

One of the key benefits of developing such infrastructure as pointed out earlier is the benefit the northern communities of Canada are likely to receive. Unlike the Russian side which has quite a high population, the Canadian side is not the case. The increased activities in the Northwest Passage will, therefore, open the northern communities up and make movement of goods easier. Due to the nature of the Canadian Arctic, communities are mostly accessible by air. This is normally expensive. A special case of a town called Churchill which has a railway, a port and an airport. This makes a town such has Churchill located in the Canadian Arctic very important to opening the north. This critical infrastructure can be so important that a damage or non-function of any create a huge impact in the community (A. K. Ng et al., 2018).

This chapter examines the role of the Churchill port as an example of how climate change and its impact on shipping are likely to bring wealth to an otherwise remote community and the consequences as well when these facilities do not function or are underutilized. The latter examines some of the challenges these communities are facing and what can be done to improve the situation. The case of Churchill may be peculiar regarding how the effects of climate change has both positive and negative impact on one community. On one hand, the effect of climate change is likely to open Churchill to businesses and increase revenue for the Port and the government. On the other hand, there is the challenge of the massive impact on infrastructure thus the erosion of the railway through flood.

The European Union (EU) in their report on the effect of climate change on transport infrastructure, outlined how adverse weather conditions can cause flooding and so interrupt essential transportation infrastructure like bridges and railways (EEA, 2014). Further, Schweikert et al. (2014), presented a study which is representative of the world-wide impact of climate change on roads. The study concluded that there is a tremendous repercussion of climate change on the cost and maintenance of the roads as well as the inability to connect communities.

Also, Nemry and Demirel (2012) in their report for the EU on the impact of climate change on transport, noted that the impact of a damaged infrastructure has a cascading effect for economic activities. That is to say that, a damage to a bridge or for example railway will affect the economic activities of the areas where the railway is linked. Further, Baker et al. (2010) examined the effect of climate change on railways. They identified among other things the effect that extreme weather conditions may have on infrastructure such as the railway.

The case presented is exceptional, in that it involves two essential infrastructures located in an Arctic setting affected by climate change. The case study presented shows some of the many challenges the town of Churchill faces, and this may be true for other such locations in the Arctic in the different countries. Churchill port which is the only deep-water port in Canadian Arctic will be very strategic to successful shipping business in the future should the Northwest Passage begin to experience increased traffic. The port infrastructure is however still not acutely developed to cope with a potential increase in business. This has been due mainly to less shipping activity and the high cost involved in operating such a facility. Currently, there is no incentive to continue to ship items through Churchill port since ports like Vancouver and Montreal offer better services to China and Europe.

However, looking ahead, the Churchill Township and its infrastructure will play a key role in world shipping business. Churchill is key to delivering goods to the northern communities. The port is very strategic to achieving this. The non-functioning of the Churchill port would create a complicated life for the populace. Should the Northwest Passage reach the level of the Northeast Passage, transport of goods to Churchill and other communities in the north will speed up. It is also likely to create jobs for the local people. Further, people would be willing to move to the community to work knowing they are assured of supplies.

Cost of living is very high in these areas, and so this discourages people from taking up employment. An improved and fast means of delivering cargo means that employees are assured of food and other essentials. The uncertainty about food and travel would be laid to rest.

Tourism would improve tremendously. Like many other Arctic cities or towns, accessibility in terms of cruise ships would improve the tourist potential of these places. Many

want to know how the Arctic looks and the natural fauna and flora in this area but the difficulty in traveling through ice has prevented such voyages. The ice melt, therefore, presents an unprecedented opportunity for tourism in the Arctic areas.

The rest of the chapter is organised as follows: Section 2 gives a brief theoretical background of the case, Section 3 describes the problem of the railways caused by climate change, section 4 describes the problems currently facing the people residing in Churchill and concludes.

4.2 Theoretical Background

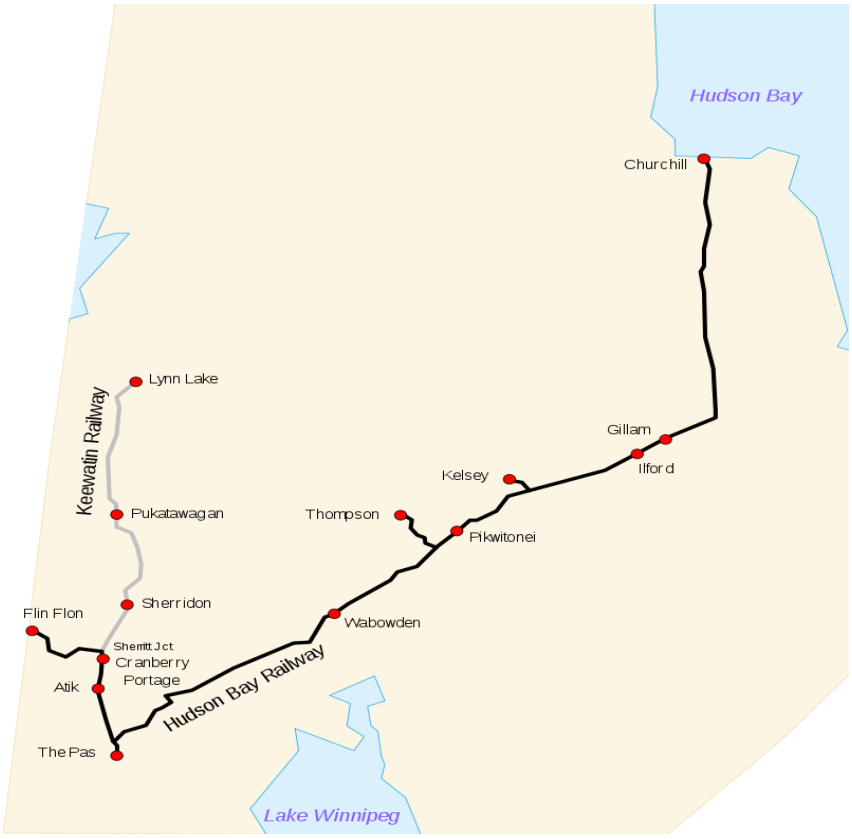
The research of 'sustainability' and 'sustainable development' has arisen the awareness of local, national and international politicians, along with entrepreneurs from different industries. With the emerging research, researchers hold different opinions on the meaning of these terms, and the approaches of pursuing sustainability. The commonly cited definition of sustainable development refers to the development which meets the needs of now without compromising the needs of future generations (World Commission on Environment and Development, 1987). Agyeman et al. (2002) have argued that a real sustainable community is one that social welfare and economic are integrated into environment capacity.

Different from traditional concept, the framework of sustainability from the conventional 'environmental sustainability' to a holistic view of 'the environmental, social and economic sustainability' can be regarded as a movement toward sustainable communities. Egan review and EU Bristol Accord identifies eight characteristics of an ideal sustainable community that include environmental, social and economic dimensions. These characteristics emphasized the importance of governance, transport, services, social and cultural activities, a healthy environment, housing,

economy, and equity. These eight characteristics are not unachievable goals. Technically, they are feasible, and each characteristic can be found in different communities. However, it will be noted that if 'sustainability' referred to a community encompass all these characteristics, no community on earth would be qualified as a sustainable community. The purpose of these characteristics is to act as guidelines for stakeholders in communities, entrepreneurs and policymakers and a framework in pursuing sustainable communities. Roseland argues (1998, p.2) that the process of pursuing sustainable communities enables communities to achieve better accessibility, cohesion and efficiency in resources.

Although the importance of transport and connectivity are mentioned in the table, they tended to be left out in other literature or report made by the local government or international organizations. Department of Transport, Environment and the Regions (1998) listed 17 characteristics of a sustainable community but transport and connectivity are not included in this list. To highlight the importance of transportation to sustainable communities, more works are needed.

Figure 1 The map of the Hudson Bay Railway



Source Image: Canada (geolocalisation).svg by STyx

Several studies have examined the vulnerability of supply chain in individual company (Juttner, Peck, & Christopher, 2003; Peck, 2005; Svensson, 2000). They established the need for the individual company to conduct risk analysis and adopt proper measures to improve the resilience of their supply chain. From a micro-level perspective, researchers concentrate on businesses or individual supply chains. This chapter intends to present the results of a macro-level assessment of a railway disruption by examining the process of economic degeneration and dislocation of supply networks in the transportation system. We explore the influence of railway

disruption with specific reference to Churchill in northern Canada. We touch on some issues that relate to social sustainability, transportation system, community-cooperation relationship, and community empowerment. The target readers of this chapter are government officials, company managers, and the public. A subsidiary aim was to investigate the conflict between regional development and transportation system or even private sector, developing an operation system that sustains the quality infrastructure for the local community or even Arctic shipping.

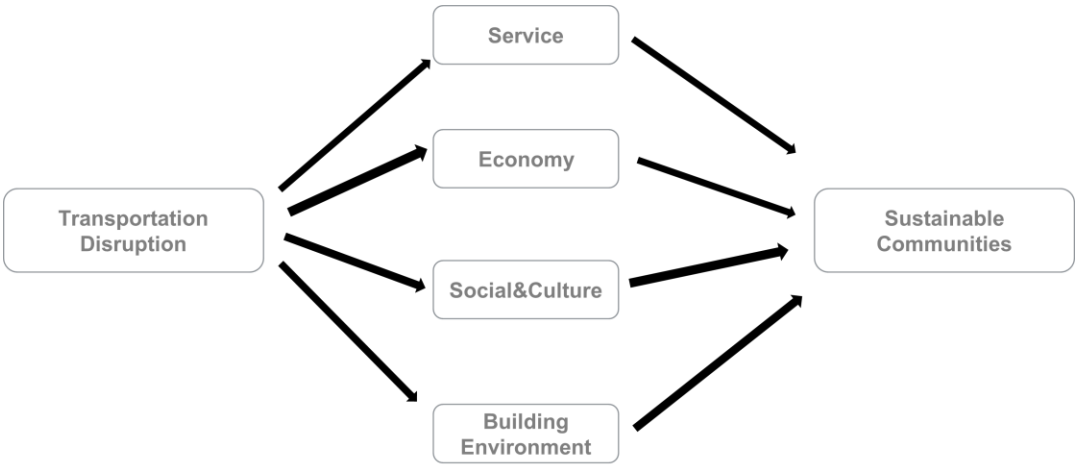
Figure 2 2017 Churchill Railway Washout

Source by Yufeng Lin

4.3 Impacts on characteristics of sustainable communities

Attention will focus on the following characteristics as they have been discussed by participants and these characteristics are directly influenced by railway, exerting a strong influence on the quality of life. These sectors include service, social & culture, housing & building environment and economy.

Figure 3 Conceptual model of how Transportation Disruption influences The Development of Sustainable Communities



4.3.1 Service

Postal service in Churchill is mainly influenced by the freight cost. Cars or furniture were previously shipped by train. Currently, however, these products need to be barged in, resulting in critically high freight cost. If the absence of this railway lasts, Canada Post may raise their rates to accommodate the extra cost of alternative transportation. Local Business would be severely impacted by the disruption of parcel delivery. When the shipping rate of a product increases, the

cost will be passed to the businesses and ultimately the customers. Local business needs to order many products to reduce freight cost, so more capital is required. To make the order with less cash in their hands. Product such as like chemical and oil products needed by Churchill Northern Study Centre must be scheduled six to eight months in advance.

Health services no available in Churchill has stopped since the disruption of the train. The only alternative is taking a plane to Winnipeg while a round-trip ticket to Winnipeg can cost around 1400 Canadian dollars and would most likely discourage people from having these flights.

Fuel supply service has lost a transportation option, resulting in increasing price and unstable supply. In June 2017, the average price of gasoline in Winnipeg pay is $1.17 per liter. The price in the Churchill's only gas station soared to $2.17 per liter. The town used to receive the gasoline by train, but now their options are barge and airline. However, the price of fuel supply is still more expensive than cities in the southern Manitoba. Motorists and operators of vans and other utility vehicles users would feel the pressure of fuel shortages. Non-essential trips may be cut due to fuel cost and car occupancy rates.

4.3.2 Economy

The price of groceries in Churchill has skyrocketed as groceries now arrive by plane. Without railway, stocks of produce, chilled products and fresh meat in supermarkets would be quickly consumed. The price at the local Northern store can be two to four times higher than the price in a southern Manitoba grocery store for the same item. Affordable Food in Remote Manitoba (AFFIRM) was launched in Churchill in October 2015 with a subsidy rate of $1.20 per/kg. The new subsidy rate of $1.60 per/kg is the highest rate offered to Manitoba communities in both the AFFIRM and Nutrition North Canada (NNC) program. The subsidy is provided to participating

stores, and each store is required to pass on the full subsidy to the customer by reducing the sale price of milk, fresh vegetables, and fresh fruit. Any store that sells milk, fresh vegetables or fresh fruits in eligible communities can apply to participate. Even with a northern allowance to compensate the community for the extremely high prices, the cost of grocery is still going up.

A four-liter jug of milk that once cost 6.19 Canadian dollars is now $10.89. Instead of paying $4.97, 2.63 litter Orange Juice is now $14.29. Housewares like detergent is three times more expensive than it is in south Manitoba. The cost of dog food and cat food has doubled. People used to take the overnight train to a nearby town, Thompson, a few times a year for cheaper meat and suppliers. This option is no longer available.

Table 2 Price index in Churchill and Winnipeg

Content	Volume	Price in Churchill (Northern)	Price in Winnipeg (Superstore)	Pc/Pw (%)
Grocery				
Tropicana Orange Juice	2.63 L	14.29	4.97	287.53%
Danone Activia Yogurt	650g	6.09	3.87	157.36%
Beatrice Milk	4L	10.89	4.59	237.25%
Beatrice Milk	2L	5.95	3.2	185.94%
Lays Potato Chips	255g	5.85	2.47	236.84%
Wonder bread white	570g	5.25	2.48	211.69%
Produces				
Apples gala bag	3LB	4.99	3.49	142.98%
Broccoli iceless	per each	10.79	2.97	363.30%
Blade Steak, boneless	per kg	25.79	13.48	191.32%
Houseware				
Tide liquid high eff orjg	1.47L	15.89	5	317.80%

The Liquor Mart in Churchill itself lost over 50% of sales. Without the train, the liquor store does not have people coming from other community. Also, it lost the far north customers as Churchill cannot supply them at the same price with the freight cost going up to 95 cents a pound. The store is not as profitable as it used to be, resulting in the sales going back to the distribution center in Winnipeg. When they ship liquor from Winnipeg up north, they make customers pay for their freight instead of paying the freight by using their pocket.

Churchill heavily relies on tourism, especially in the summer season when Beluga whales show up in the Churchill River and polar bear season, which starts from the middle of October and ends in the late November. Hotels and tour companies have had cancellations, with the price of travel now out of reach for many visitors: regardless of the commuting cost to Winnipeg, plane tickets from Winnipeg to Churchill can cost as much as 1,400 Canadian dollars round trip. Independent travelers were expected to fill the gaps between the busy seasons or even the hours between tour groups, but they are more sensitive to the fluctuation of commuting cost than family or tour traveler. Without the train, there was a sharp decrease in the number of independent tourists this summer. People need to think twice before they head to Churchill or leave Churchill for a trip as the commuting cost has doubled. When employers hire people outside Churchill, usually they offer a train ticket, but now employees need to consider the increasing cost or employer need to afford the commuting cost if they decide to work in Churchill.

The town of 900 people had lost 93 full-time jobs one year after the closure of Port of Churchill (Kives, 2017). In addition, freight service to the community was cut back before the Hudson Bay Railway was washout. There are only 20 people still working in the port at this moment as many people did not get a call-back from the company. The subsequent closure of the Hudson Bay Railway results in the spinoff effects on the tourism and the transshipment industry.

Due to the decline of customers and increasing commuting cost, employers need to cut down on the employees they were going to have. The closure of the port and rail line led to staff reductions at Churchill hotels. A local hardware store used to have ten employees, but the closure of the railway makes the employer send eight people away as a business with North community is shut down with the railway. Flying stuff to the north is not a smart way to do business. Meanwhile, laid-off Churchill workers either took up other jobs, left the community for work elsewhere or remain unemployed. Without an adjacent community, people either leave their family in Churchill or move south together.

4.3.3 Social &Cultural

The washout and uncertainty of the Churchill railway do bring a concern to the local community. More than half of our participants have mentioned the word "frustrated" and "uncertain". They are frustrated about the disagreement and conflict between the government and Omnitrax, leaving them without no train and abandoned. Also, the uncertainty of the railway being repaired in the future is growing among the community. One of our participants said:

Moreover, then psychologically, if you continue seeing how people talking and are frustrated by the situation, it creates a lack of optimism anywhere. If a community is lack of optimism, then you are not going to have entrepreneurial as people think your community is dying. You are not going to have someone come here, thinking they should take a chance and spend some money to start a business when you have that uncertainty. If you ask somebody who likes it here about the population in Churchill, they will give you the Statistic Canada figure, which is around 900. If you talk to people who are here for the money or don't like it here, they will tell you eight

or seven hundred. Because those here who are for money and they thought here was just ok, but they do not like it all that much, or they just want to find a gold mine, a good reason to be here not very long, and then whatever.

It also creates a mist to the public. One of the participants commented about Churchill:

There was a mist like. Don't go to Churchill; they have a state of emergency. They have no food. There are many people who are in that mentality. The media and advertising turn around like please come to our community and support our economy. Some people are coming because they want to help, and some people are not coming because they want to help us as well.

4.3.4 Building and Housing environment

The Churchill Marine observatory is a thirty years program, cash 44 million dollars. The Churchill Marine Observatory (CMO) represents a first-of-a-kind facility for the circumpolar Arctic, which would dramatically advance knowledge of Arctic environment. Without the train, CMO has been in a difficulty of getting materials from Winnipeg. If this project is canceled, it minimized the contribution that Churchill can make, especially on research. Regardless of the difficulties CMO is facing, residents must deal with transportation corporations in Winnipeg or Montreal for a delivering method of building materials. Extra cost or time are added to construction plans.

4.4 Discussion

Following the disruption of rail transport, the level of economic activity would drop sharply in the days. In a short period, the community would be plunged into a deep economic and social crisis like unemployment and food scarcity. Without help from the government, many businesses

would not survive a lengthy suspension of their operations. Most local businesses have fragile trading and cash flow (McKinnon, 2006). They would not be able to withstand even a temporary loss of business. One participant who has worked for the port and living in Churchill over ten years said:

I think the possibility for Churchill is significant but the opportunity is slowly going away because some of what's happening here. No freight coming through, so no one can do business. They must look at elsewhere to get their products or material or whatever. So, a lot of the shipping that was done through here to the North, now they must go to Montreal. Once they established that, which they have been doing that anyway, so when the railway is fixed, are the customers going to come back? They may say it is easier to get stuff in Montreal; I just need one phone call for whatever reason. Maybe customers will not come back here. Maybe they will say there are too many problems with Churchill, I do not want my stuff stuck there again, and then I have to pay for getting shipped from Thompson and then to Montreal and then come back. Like this year. Things are just moving slowly away from Churchill.

The Churchill railway is not merely lines that run from one place of origin taking tourists or cargoes to a terminus. It is a component of vast, complex technological and economic systems that entail far-reaching change, about which indigenous and local communities in North Manitoba are currently attempting to make their concerns known and heard. The debate of repairing the railway is significant in that it also highlights issues of social and cultural diversity, which are also often neglected in discussion of human-cooperation relations in the North in the context of plans for transportation industries. As the railway passed some communities, especially communities having no access to airline, it cannot be a project that affects Churchill local communities solely, but one that other isolated communities shaped by the historical and contemporary presence of

settler societies also feel compelled to speak out about. A participant from the train office in Churchill said:

Will Churchill have extra money for new port or better road? I do not know…It is more about the security. It is going to generate jobs, investment and eventually, may generate some sort of service to Churchill but most importantly, it is going to secure your 'say' in that transportation and our community. Even though Omnitrax is all good and communicating. At times, they just change and shut down. We have no control over. We have no say in how fast it is going to come back up. However, now as an investor, a stakeholder, you do. We are going to do maintenance from now to then…Unfortunately, some of the information should be open to the public. A company like Omnitrix, I can't say that they didn't know, or may they didn't want to know but even if they did know, it was not going to change anything because it is all about how much money you put in and how much you get back. Look at an industry like this, entirely dollars and cents.

Taking the Churchill Railway back from a foreign cooperation is supported domains but, like the other replacement of ownership in the transportation industry in North America, they serve only as a staging ground upon which the mechanisms of cooperation are deployed. The operation of public transport made apparent the contestations between operating cooperation's interest and regional development, with the local community, especially indigenous community, expressing frustration at the way Omnitrax operating the railway had not provided proper action to maintain the railway and sustain the job opportunities for the local community.

The tension between the private sector and regional development outlined above is, of course, somewhat simplified, and we are not suggesting that the oppositions are irreconcilable. On the contrary, we might witness hybrid forms emerging from being a private sector and being

indigenous as First Nations consortium is trying to buy Churchill Railway, cooperating with FairFax, a Toronto investment firm.

We believe that it is a significant issue to stress since previously, Churchill community' struggle for port authority, being indigenous and occupying a different space underwrote the demands for autonomy while now the quest for autonomy possibly challenges what it means to be indigenous. On a more general level, being indigenous is typically posited as a challenge to common cooperation operation mechanisms based on the free market.

CHAPTER 5: LOCAL TRANSPORTATION SYSTEM AND PUBLIC-PRIVATE-PEOPLE PARTNERSHIP

5.1 Introduction

Public-Private-People Partnership (4Ps) is recognized as a collaboration by three sectors different sectors in the society. Naturally, researchers have been focusing on the public-private partnerships (Buse & Walt, 2000; Klijn & Teisman, 2013). In recent years, public-private relationship has moved beyond the dyadic relationship and started to involve "people" like non-governmental organizations (Kumaraswamy, Zou, & Zhang, 2015; Perjo et al., 2016). However, managers and politicians have realized that a triad relationship is complicated to operate as more players are involved, and the conflict of interest and purpose may lead to disagreement over a project.

While studying the literature on the dyadic relationships between people and public (e.g. (Huxham, C., & Vangen, 1996)), public and private(e.g.(Busch & Givens, 2012; Buse & Walt, 2000; Klijn & Teisman, 2013)), private and people(e.g. (E. Innes & Booher, 2000; Giannakis & Papadopoulos, 2016)), we came to realize that all these three relationships are pieces of a same puzzle- Public-Private-People Partnership. For instance, public sector like the government have to take people's welfare into account when they interact with private sectors; therefore, given the ideas above, we propose to study the dynamic triad relationships in 4Ps.

Through this theoretical lens, we specify the transformation of unbalance states to balance states. We proceed to analyze relational dynamics in the transformation. By injecting balance theory into 4Ps, we then explore the triad relationships in 4Ps and understand the tendency of unbalance and balance states.

5.2 Literature Review

5.2.1 Balance theory

Balance theory was first based on behavioral psychology, proposed by scholars who focused on interpersonal relationships in social groups (Alessio, 1990; Davis, 1963; Davis & Leinhardt., 1972; Newcomb & Heider, 1958; Taylor, 1967). Balance theory is a theory that addresses triads explicitly while triad exists in 4Ps. The theory may only apply to interpersonal relationship firstly, but researchers have applied it to larger social sectors like organizations (Cimeno & Jeong, n.d.; Gimeno & Woo, 1999; Ravindranath Madhavan, Gnyawali, & Jinyu, 2004; Monge & Contractor., 2001). Also, how the balance theory demonstrates a relationship is similar to what has been captured in 4Ps literature - whether each two sectors maintain a positive or negative relationship (e.g., Busch & Givens, 2012; Klijn & Teisman, 2013).

The logic of balance theory can be explained by the relationship among husband-wife-child. Apparently, the balance state is achieved when three of them maintain a positive relationship with one another. However, the balance state would be destroyed if the husband likes the child while the wife does not. Under this situation, an unbalance state happens as the child is simultaneously adored and hated by the husband and the wife. Alternatively, if both husband and the wife end up hating the child, a balance state is achieved as they have a common enemy. The logic here is my enemy's enemy is my friend.

As argued above, we are trying to apply balance theory to a group or organization level. A plus (+) sign indicates a positive relationship based on common interest and goal (Morgan & Hunt., 1994; Uzzi, 1997) while a minus (-) sign represents a negative relationship emerged from inequity and distrust between two firms (Griffith, Harvey, & Lusch., 2006). A balance states usually have

two minus signs and one plus sign or three plus signs, and unbalance states have three minus signs or two plus signs and one minus sign (Hummon & Doreian., 2003).

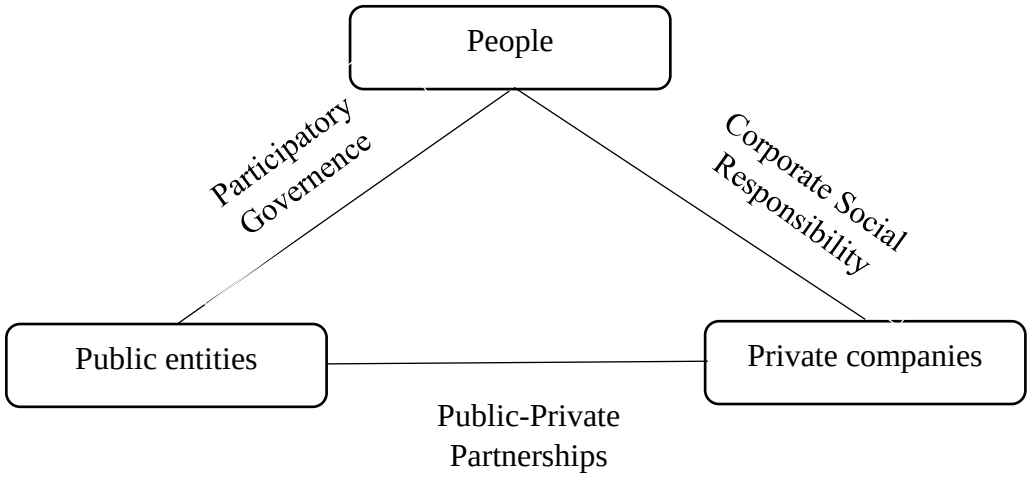
Based on the literature, an unbalanced state tends to transform into a balanced state (Anderson, 1975; Morrissette, 1958; Rodrigues, 1983; Rodrigues & Coleta., 1983). This characteristic is indicated in the "structural theorem" (Cartwright & Harary, 1956). Each node in unbalance states tends to address the inequity or mistrust in the relationship so that the balanced triad can be achieved (Newcomb & Heider, 1958). This tendency helps to understand the establishment and nature of relationship in a triad situation. For example, in a three-firm triad, if firm A and firm B individually has a positive relationship with C, they are more likely to build a positive relationship. Under this circumstance, positive relationship is "transitive" as A and B's positive relationship is based on their cooperation with C (Alessio, 1990; Davis & Leinhardt., 1972; Newcomb & Heider, 1958).

5.2.2 Public-private-people partnership ("4P")

Emphasizing the importance of users in the transportation system is reflected in the concepts of partnerships that share common tasks. One approach to transportation management involves the use of the public-private-people partnership (4P) concept, which assumes that for different ways of collaborating and sharing public and private actors in the creation of products, services or policies (public-private partnerships), also members or non-affiliated users ("people") are added. This is " to increase transparency and democratic accountability, and more effectively to include citizen knowledge and to create environments and services that better respond to citizens' needs" (Perjo, Fredricsson, and Costa, 2016, p.2).

As Paskaleva points out (2015, p. 118), 4P means engaging citizens in all aspects of the design and delivery of public services, where both citizens and public authorities are responsible for these processes. In this way, the inhabitants become co-producers and co-creators of new services. The popularization of the 4P approach is about risk sharing, cost, and more effective (more beneficial) project implementation (Klijn & Teisman, 2013). At the same time, attitudes focused solely on efficiency and savings objectives in the public sector while benefiting the private sector, which may result from small public contributions, lack of transparency, and limited consideration as to the quality of life of the population are criticized (Perjo et al., 2016). If the requirements for the investor are not properly formulated, it will focus on financial benefits and not on improving the quality of life of the population. When creating 4Ps, public authorities are also responsible for securing public benefits.

Figure 4 Existing relationships between different characters in the 4ps model



Public-private partnerships (4Ps)

Based on a formal or informal arrangement, the partnership could be formulated before a crisis or on ad hoc activities happening in the middle of an emergency. The public entities play

critical roles in fulling the need the public, but the number of critical infrastructures owned or operated by private sectors is increasing (Boin & McConnell, 2007). Nowadays, both public and private entities take responsibility of providing resources and service to the public in terms of critical infrastructure protection. To ensure critical infrastructure protection, facilitating cooperation between both entities through 4Ps is required (Busch & Givens, 2012)

Participatory governance

Participatory governance is regarded as a critical factor that contributes to urban community resilience (Schauppenlehner-Kloyber & Penker, 2016). Governance refers to the process and institution facilitating public decision-making. Participatory governance, as an institutional strategy to develop governance, is to achieve the desired outcome (United Nations, E., 2007). Participatory governance has become more and more common since the last decade. For instance, getting citizens involved in the decision-making and planning processes of pipeline planning is becoming a routine in developed countries, as many decisions regarding with city resilience, let alone the part directly affected, end up influencing citizens' livelihood indirectly.

Corporate social responsibility

In terms of purpose and interest, the difference between public and private sectors is remarkable (Marques & Mintzberg, 2015; Saleem, S., Kumar, & Shahid, 2016). The primary task of private sectors is to achieve maximum profit while more and more private companies claim that contributing to development of society is in line with their interest (Boulouta & Pitelis, 2014;

Devinney, 2009). Corporate social responsibility refer to corporations' voluntary intention to incorporate social and environmental factors into their operation and strategies (Commission of the European Communities, 2001). Aiming to build a positive impression or even contribute to the welfare of the society, the number of private companies implementing these policies is increasing. Some researchers claim that the implementation of corporate social responsibility strategies can lead to increased financial performance (Husted & de Jesus Salazar, 2006).

Incorporating "public", "private" and "people" into transportation system

In the past, the interdependence of these actors can be demonstrated as public authorities have a limited impact on market processes where private and people are involved, the private sector cannot control a representative democracy, and the people have no influence on the relations between the public and the private sector.

It is difficult to involve stakeholders because of the respective goals of "public", "private", and "people" (McConnell & Drennan, 2006). Collaboration and partnerships are regarded as two of the most important parts of resilience planning and the most challenging ones (Kapucu, 2012). Public entities are expected to represent a society viewpoint but how people and public sectors miscommunicate may result in the misunderstand the same situation (Rich, Edelstein, Hallman, & Wandersman, 1995). However, if "public", "private", and "people" realize that their partnership could provide a common platform to create better strategic coordination approaches, the partnership may become reality.

Michael Berkowitz (2016) has emphasized the involvement of different stakeholders in the development of resilience and improvement of livelihood in a community. Under the context of

local transportation system, the need to facilitate multi-level governance can be met by coordinating relationships in 4Ps.

5.3 Conceptual Framework and Propositions: Triadic state of 4Ps

In terms of the transportation system, public-private-people partnerships consist of the following entities:

- Public sector:
  - Politicians (including the mayor of the city) - decide on relationships with the private sector and residents
  - Civil servants, including planners of various levels, carry out public-related tasks related to the transportation's development
- Private sector (financiers, developers, architects, consultants, small and medium enterprises, commercial actors)
- People sector (individuals and formal and non-formal associations, e.g.. First Nations Manitoba or Union of Canadian Transportation Employees)

In such an arrangement, the actors' roles are as follows:

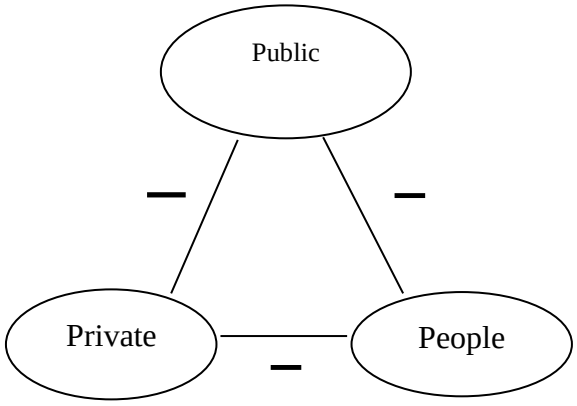
- Public: steering transportation development - provide resources and long-term development framework
- Private: providing appropriate services and to the transportation system

- People: social groups mobilize citizens for the actions of the transportation system/influence on the development of the transportation system

In an unbalanced triad relationship, inequity brings instability for sectors in the relationship (T. Y. Choi & Wu, 2009; R. Madhavan, D.R., & He., 2004; Rodrigues & Coleta., 1983). To address relational uncertainty consuming extra resources, sectors in the triad tend to move toward balanced states. An unbalance state with three minus signs is shown in Figure 4. In this triad, public, private and people sectors remain a negative relationship with one another.

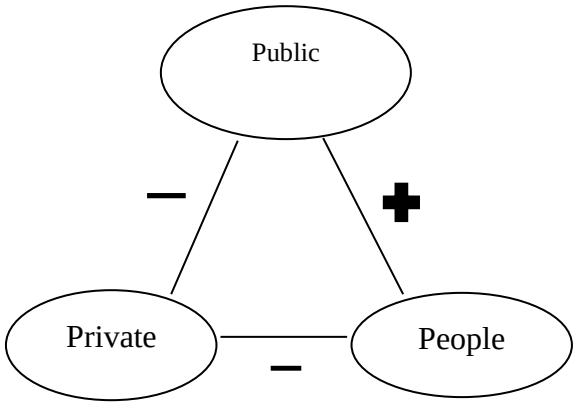
For instance, the private sector mistreated the government and resident suppliers by polluting the environment or offer poor public transportation service. The relationship between the private sector and people or the public sector turned into a negative one. Also, people tend to blame this situation for the government if the government acted passively and slowly toward the situation. As identified in Figure 4, each connecting line indicates a negative relationship between every two nodes in the triad relationship.

Figure 5 The unbalanced state of 4Ps



In this unbalanced triad, each node remains a negative relationship with one another. As identified above, an unbalanced state is unstable and will not last. This relationship structure tend to transform into a balance state (C. R. and T. Y. Choi, 2005). One of the three sectors is going to change its strategy towards other sectors. Consequently, two nodes of the three would be drawn toward one another. The private sector is likely to remain their initial attitude towards the other sectors, namely negative relationships with one another as private sectors have different interest and goal from public sectors and people. When the public and people realize their collective state of negative relationship with private sectors, the public sector and people tend to develop a positive relationship so balanced state we achieved.

Figure 6 The balanced state of 4Ps



Proposition a: Without initiatives of the private sector to improve its relationship with other sectors, “public” and “people” tend to cooperate to counterbalance their negative relationships with the private sector.

However, there is a chance that the private sector proactively addresses the negative relationships. Based on figure 5, improving the relationship with both sectors would create another unbalanced state; therefore, the private sector is more likely to improve the relationship with only one of the sectors.

Proposition b: With initiatives of the private sector to improve its relationship with other sectors, private sectors tend to improve relationship with only one of the sectors when the other two sectors remain hostility.

5.4 Relationship management perspective: The operation of Churchill transportation system

5.4.1 Background

Hudson Bay Railway (HBRY) was operated by Canadian National Railway from 1929 to 1997 until OmniTRAX, an American private company, took over the ownership. Meanwhile, OmniTRAX took over the Port of Churchill from Transport Canada. The Railway operation includes technical and commercial activities as well as maintenance. In August 2016, the port of Churchill and all connected freight railway service were shut down by OmniTrax after the end of Canada Wheat Board monopoly, which consequently encouraged farmers to sell wheat through

economical transport routes. On May 23, 2017, OmniTRAX claimed that because of severe floods, the railway between Amery and Churchill was closed indefinitely(CNW, 2017). It is uncertain when the railway will be repaired as a disagreement over which entity takes responsibility of repair the railway is uncertain. Losing access to rail service has influenced the tourism industry, imposing high freight cost on Churchill's already-fragile economy (Robertson, 2017).

5.4.2 Private-Public relationship

The Canadian Wheat Board (CWB) played a critical role in the economic feasibility of the Port of Churchill, also Omnitrax. With the privatization of CWB, large producers and shippers tended to cooperate with railway corporations and ports across Canada and U.S. Consequently, the synergy between policy purpose and business interest was destroyed. In addition, some whear and commodity shippers who own port facilities under the implement of the port authority were motivated incentive to utilize vertically integrated port facilities. However, the fact that the port and railway are owned by the same company makes port of Churchill an exception of the new policy framework; therefore, the port of Churchill lost its commercial attractiveness. The relationship was based on an arrangement that Omnitrax would be able to receive subsidies from the government. When that stopped, Omnitrax tried to get rid of the responsibility of repairing the railway while the Canada government using the law as a weapon to protect its interest. The relationships between the private and public sector turn into a negative relationship, and they remain this negative relationship through the argument of who is going to repair the railway.

5.4.3 Private-People relationship

Across the Canada North, there are remote communities like which only have access to either airline or railway. Churchill was lucky to have both. Losing its access to railway could result in sever social-economic crisis as the transportation system is considered as a critical part of livelihood and the region economy due to the role it plays in supporting socioeconomic activities and connecting other adjacent area (Shinozuka, M., Rose, A., & Eguchi, 1998). The interregional transportation network increases interregional trade and human mobility, contributing to regional economic progress (Tatano & Tsuchiya, 2008). Transportation disruption emerged from a nature disaster would have a severe impact on the region economy, as witnessed the Hanshin-Awaji earthquake of 1995, the Niigata-Chuetsu earthquake (mid-Niigata earthquake) of 2004 and now the Churchill Railway washout of 2017. Also, the disruption can hinder the process of Arctic shipping. With such severe consequence, participants expressed their disappointment by Omnitrax escaping from social responsibility. The shut-down of port took away many job positions while the lagging repairmen of the railway have resulted in fewer tourist, which brings less business to the local community. With the observation of most participants, minimum maintenance has been conducted and lacking maintenance significantly contributed to the wash-out of the railway. Corporate social responsibility is the bond between private sectors and people. When the private sector fails to fulfill its responsibility and damage the welfare of the society, people will express a negative attitude.

5.4.4 Public-People relationship

“People” act as the relatively new player in the triad relationship can cement 4Ps, stabilizing factors in an unstable equilibrium (Kumaraswamy et al., 2015). To achieve a common

goal, participatory governance is utilized as an institutional strategy in a public-people relationship. A consortium was elaborated to make a deal with Omnitrax. The consortium includes two groups: Missinippi Rail Partners, which represent northern communities and First Nations and Fairfax and AGT Food and Ingredients. The Churchill Mayor, Michael Spence plays an important role in the consortium, and he comments on the buying consortium, "Our buying group is united. We remain at the table, and we fully support the efforts to conclude a reasonable deal (CBC News, 2018)." Also, First Nations as a people sector shows how participatory governance works when they try to put a group together and put up a deal. This partnership shows a positive relationship between private and people sector. Although participants express their disappointment about selling railway to a foreign country and the plan of railway resilience moving so slow, they do appreciate the efforts made by local town office and the Mayor of Churchill. It suggests a relationship changing in this process: from negative to positive.

5.5 Discussion

4Ps involves long-term, multi-organizational contractual relationships (Akintoye, Hardcastle, Beck, Chinyio, & Asenova, 2003), including "public", "private" and "people". As balance theory apply to triad relationship, injecting balance theory into 4Ps could be a way to develop and improve organizational structure efficiently. Based on the 4P scenarios discussed above, the prediction of relationship involved in 4P projects implies even better relationship management. Correspondently, identifying the fundamental needs for a successful relationship in 4Ps and injecting the balance theory can provide a new tool for managing 4Ps as it predicts the tendency of relationship. This yields positive influence on coordinating relationships between

every two players in 4Ps, especially with the current focus on sustainability. Although downsides such as complicated negotiation and decision-making process may emerge from 4Ps, but stakeholders could make better synergistic contributions to programs that need cohesive collaboration.

However, there are questions needed to solve in the process of incorporating balance theory into 4Ps: how to select and get involved the "right sectors" and manage common goal and interest and correctly, how to build a balanced structure for 4Ps. Ideally, under the balance state, the public sector provides viable conditions; the private sector offers financial support and commercial perspective; people sectors, namely non-governmental organizations help to formulate, implement and propagate the transportation system development more practically and efficiently at a grassroots level (e.g. professional authority offer opinions and the media could raise public awareness). With the collaboration of people, public and private sectors, all these result in injecting greater values into the project design, mobilization and optimization of resources for construction and operation, and maintenance. To achieved what is identified above, balance theory could act as a relationship management tool to reinforce commitments and sustain relationships, to meet agreed objectives more efficiently.

CHAPTER 6 CONCLUSION

6.1 Summary

The deal of Churchill railway and the port of Churchill is still under intense discussion when we finished our research in June 2018. Not only Churchill itself is influenced by local transportation system but also regional or even national area are impacted. Due to Churchill's proximity to the North community and Arctic, the railway and port are expected to have higher value. To study the potential negative impacts posed by the disruption of local transportation system, stakeholders are invited to share their perception. However, the disagreement among people, public and private sectors is still a challenge to proceed to the next stage of repairing the railway. The present study is designed to tackle this problem by investigating how different involving parties can achieve cooperation.

Recognizing the problems that hinder Arctic shipping, Chapter 3 critically reviews the factors that may contribute to the success of Arctic shipping. For example, what is the perception of indigenous people towards Arctic shipping? Is Arctic shipping economically viable? Understanding that the existing conditions fail to solve the issues of Arctic shipping, a case study of Churchill is conducted to call for a research focus on the quality infrastructure on the land so as to achieve a breakthrough.

Secondly, given that the literature review emphasizes the role of transport & connectivity in sustainable communities, Chapter 4 explores the influence of transportation disruption on Churchill. By conducting interviews. Service and economy are the sectors that are influenced the most by the disruption, while the social & culture and building environment are also damaged. No matter in service or economy, Churchill residents have a far better knowledge of impacts caused

by the disruption. Also, the results indicate that the disruption of railway will give rise to more serious even disastrous impacts in the Canada North community. Because of the importance of local transportation system, a paradigm shift in operation is imperative and collaborative work with all the stakeholders involved is required, especially given growing importance of Arctic shipping.

Additionally, with acknowledging the interest conflict of stakeholders from different sectors, the thesis examines the 4Ps through a case study of Churchill and the utilization of balance theory. The aim is to further explain the findings in Chapter 4 through stronger theoretical explanation and to examine the constructive suggestion proposed in the literature review of Chapter 5. The primary impact of local transportation system on the community has been identified as service, economy, social & culture and building environment. As the only deep-water port in Canada, the port of Churchill with a sustainable railway system could have play a critical role in the development of future Arctic shipping, if an appropriate operational model was developed. Although with a better understanding of 4Ps, the stakeholders still find it difficult to proceed to the 'collaboration level' of planning, funding, and implementation. The unclear responsibility of individual sector is still under debate. To address this issue, the author trace back to the undefined and vague allocation of responsibilities in 4Ps, and further, recommend a potential collaboration method based on the balance theory. Establishment of a neutral empowered agency (like a collaborative network) is proposed to address the leadership problem, promote the local transportation system and make further progress. A flexible combination of engagement in collaborative projects and individual efforts is also recommended to Churchill for local transportation system.

6.2 Discussion

When the flood hit Churchill in May 2017, one of our participants commented, “We have a disruption in train service like four or five years ago in summer. We did not feel this impact cause as soon as the rail went down, people were repairing it. However, now when the train is down, no one is looking at it.”

Based on what the interviewees’ opinions, there is only minimum maintenance going on the railway and the port. The flood might be the main reason why the railway is washed out, but lack of maintenance and preparation for the melting ice greatly contributes to the disaster. Most of our participants mentioned the problem of maintenance, one of them cited: “when we were with port Canada, they have a maintenance program with repairing all the machine, the equipment and whatever needed to be repaired before the spring season started. When Omnitrax takes over, that ended. A lot of what they are doing is they wait until it breaks and then order a whole new one.”

The dominos have fallen: the railway needs probably two-decades maintenance, Churchill is suffering economic losses, and northern communities are cut off from essential services. Canada has lost a third of its railway track miles in the last three decades. Abandonment may generate more profit for CN and CP, but their increased profit should not be regarded as an improvement in the overall efficiency of national transportation system; therefore, abandonment of railway lines cannot be merely a rail company’s decision without people being compensated somehow. Also, governments have been far too lax in upholding people’s interest in this matter.

In recent years the voice of the local community in the transportation system has flooded the news or even policy discourse and has resulted in a shift towards the ‘port authority’. According

to a policy brief by the Union of Canadian Transportation Employees (2016), if the conditions and requirements in the statute are met, the Port of Churchill could migrate to a port authority under the regulatory purview of the Canada Marine Act (Section 8(1)).

As for Churchill, the solution lies not in suing Omnitrax for its predictable failures, but in working with northern Manitoba First Nations and nationalizing both the line and the port facilities to restore the Port of Churchill as an essential fourth western grain shipping route; therefore, a 4Ps framework should be built for the transportation system.

6.3 Contribution, limitation, and implementation

Both sustainable development and local communities have become somewhat overloaded theoretical and programmatic concepts, used and defined in a variety of ways and meaning. Despite the recognition of this, they are still increasingly and severely linked in both the academic and the policy-based literature; and it is more and more common that the engagement of the local community is demanded in the development of a sustainable community.

Moreover, exploration of these relationships is a critical basis or foundation for progressing the theories and policy debates associated with the local transportation system. A new more autonomous modern path of transportation development can be achieved with an enhanced degree of community and civic involvement. This raises important questions concerning the generation of improved participatory and planning processes; the enhanced role of the private sector and the firm in the local community; and the critical appreciation of the role of state agencies in fostering a sustainable transportation system. This thesis provides a contemporary critical analysis of these relationships within an overall framework of 4Ps.

More specifically, through bringing together interdisciplinary social science research from a selective information case studies, the thesis will critically explore and understand the theories, policies, practices, models, and strategies related to community involvement and sustainability, and how these shapes local transportation system; identify innovative organizational structures and balance states which are constructive to community empowerment and sustainability.

The study highlights the crucial role of transportation system play in sustainable communities and identifies gaps in the existing literature. The discussion of contrary natures between local transportation system and different institutions has significant implications for understanding how and why institutions hinder the process of sustainable communities. The analysis of the relationship between the local transportation system and the sustainable community has extended the knowledge of sustainability. A constructive suggestion is proposed for future academic study and planning efforts in practice. The present study also takes the initiative to investigate the perceptions and knowledge of the transportation operation system.

Additionally, it says 'no' to conventional thoughts that if privatization is conducted, the transportation system would be profitable. One the other hand, it is consistent with the existing literature on the characteristics of sustainable communities. Although this study never has a chance to confirm the correlation between the operation system and sustainable transportation operation, it partially substantiates that more climatic knowledge can contribute to more concrete ideas on the transportation system. To author's best knowledge, this is the first study reporting local transportation system in a remote Arctic community through qualitative analysis. The influence of the local transportation system, therefore, assists in our understanding of the significant role of transportation operation. Finally, it enhances the knowledge of the current situation at transportation system. Through a case study of Churchill, Canada, the study offers evidence to the

contemporary dilemma in the local transportation system and takes the initiative to call attention to its regional efforts. Instead of merely emphasizing the importance and urgency of the sustainable local transportation system, innovative propositions (mainly based on 4Ps) are put forward to facilitate adaptation process and in addition, suggest a strategic avenue for port and railway to make the best use of their resources.

Admittedly, the theoretical proposition is a preliminary idea that needs to be further developed and verified. Also, a broader spectrum of relevant literature in a higher volume should be included to support a more comprehensive review. Propositions being applied to the transportation system are primarily from one remote community, thereby there is a need to examine the findings and suggestions with examples from other communities. The small sample size of respondents from Churchill does not allow a highly robust result for regional analysis. Further work needs to be done to establish the regional diversification in the local transportation system. Besides, it is unfortunate that recommendations in the case study are preliminary ideas that need to be further developed and verified. Given that these propositions are based on analysis of the Churchill case, the applicability to other ports needs to be further examined.

However, having said so, the study is a pioneer study in addressing an important issue that urgently requires more research. It identifies a gap in sustainability in the local transportation system and strives to fill this gap by bridging literature from sustainable communities and 4Ps. The results of the research do not only illustrate the indifferent, and sometimes resentful, attitudes of different sectors to develop transportation system, but also highlight the necessity of a paradigm shift in the transportation operation system. The thesis also highlights the importance of not just raising awareness of sustainable communities but also exploring appropriate and effective methods through the paradigm shift. This study can act as a robust platform for further research and helps

decision-makers to develop practical solutions and guidelines so as to ensure the port and the railway, their surrounding regions, and the global supply chains will be more resilient to the impacts posed by operation system.

REFERENCES

Afenyo, M.; Veitch, B.; Khan, F. (2016). A state-of-the-art review of fate and transport of oil spills in open and ice-covered water. *Ocean Engineering*, *119*, 233–248.

Agyeman, J., Bullard, R., & Evans, B. (2002). Exploring the nexus: bringing together sustainability. *Environmental Justice and Equity*, *6*(1), 77–90.

Akintoye, A., Hardcastle, C., Beck, M., Chinyio, E., & Asenova, D. (2003). Achieving best value in private finance initiative project procurement. *Construction Management and Economic*, *21*(5), 461–470.

Alessio, J. C. (1990). A Synthesis and Formalization of Heiderian Balance and Social Exchange. *Social Forces*, *68*(4), 1267–1285.

Altheide, D. L., & Johnson, J. M. (1994). Criteria for assessing interpretive validity in qualitative research.

Anderson, B. (1975). Cognitive Balance Theory and Social Network Analysis:' In P. Holland and P.W.S. Leinhardt (Eds.),. In *Perspectives on Social Network Research, Academic Press*, (pp. 453–469). New York.

Baker, C. J., Chapman, L., Quinn, A., & Dobney, K. (2010). Climate Change and Railway Industry:a review. Proceedings of the Institution of Mechanical Engineers, Suppl. Special Section on Engineering in a changing climate. *Journal of Mechanical Engineering Science.Part C*, *224*(C3), 519–528.

Barkham, P. (2017). Russian tanker sails through Arctic without icebreaker for first time.

Benedyk, I.V., Peeta, S. (2016). A binary probit model to analyze freight transportation decision-maker perspectives for container shipping on the Northern Sea Route. *Maritime Economics & Logistics*.

Berkowitz, M. (2016). *What is resilience and why does it matter now more than ever?*

Bhatttacherjee, A. (2012). *Social Science Research: Principles, Methods, and Practices*.

Boin, A., & McConnell, A. (2007). Preparing for critical infrastructure breakdowns: the limits of crisis management and the need for resilience. *J. Contingencies Crisis Manage.*, *15*(1), 50–59.

Borgerson, S. G. (2014). Arctic Meltdown:The Economic and Security Implications of Global Warming, *1*(2), 63–77.

Boulouta, I., & Pitelis, C. N. (2014). Who needs CSR? The impact of corporate social responsibility on national competitiveness. *J. Bus. Ethics.*, *119*(3), 349–364.

Busch, N. E., & Givens, A. D. (2012). Public-private partnerships in homeland security: opportunities and challenges. *Homeland Security Affairs*, *8*(1).

Buse, K., & Walt, G. (2000). Global public-private partnerships: Part I-a new development in

health? Bull. *World Health Organ.*, *78*(4), 549–561.

Cameron, E. S. (2012). Securing Indigenous politics: A critique of the vulnerability and adaptation approach to the human dimensions of climate change in the Canadian Arctic. *Global Environmental Change*, *22*(1), 103–114.

Cartwright, D., & Harary, F. (1956). Structural Balance: A Generalization of Heider's Theory. *Psychological Review*, *63*(5), 277–292.

CBC News. (2018). Purchase deal for Churchill rail line has "fallen apart": Omnitrax.

Cheng, C.-F., & Lee, A.-H. (2011). The influences of relationship marketing strategy and transaction cost on customer satisfaction, perceived risk, and customer loyalty. *African Journal of Business Management*, *5*(13), 5199–5209. Retrieved from http://www.academicjournals.org/AJBM

CHNL Information Office. (n.d.). NSR-How to get Permit.

Choi, C. R. and T. Y. (2005). On the Dark Side of Strategic Sourcing : Experiences from the Aerospace Industry. *Industrial and Corporate Change*, *19*(1), 46–60. https://doi.org/10.1111/j.1467-6486.2009.00914.x

Choi, T. Y., & Wu, Z. (2009). Triads in supply networks: Theorizing buyer-supplier-supplier relationships. *Journal of Supply Chain Management*, *45*(1), 8–25.

Cimeno, J., & Jeong, E. (n.d.). Structural Balance Theory of Alliance Formation: Competition and Cooperation in the Global Airline Industry. *INSEAD*.

CNW. (2017). OmniTRAX Announces Indefinite Closure of the Hudson Bay Railway from Amery to Churchill. Retrieved from https://www.newswire.ca/news-releases/omnitrax-announces-indefinite-closure-of-the-hudson-bay-railway-from-amery-to-churchill-627505613.html

Coffey, A., & Atkinson, P. (1996). *Making sense of qualitative data: Complementary research strategies.* Sage Publications, Inc.

Commission of the European Communities. (2001). *Promoting a European Framework for Corporate Social Responsibilities, COM (2001)*. 366 final; Brussels.

Davis, J. A. (1963). Structural Balance, Mechanical Solidarity, and Interpersonal Relations: American. *Journal of Sociology*, *68*(4), 444–462.

Davis, J. A., & Leinhardt., S. (1972). "The Structure of Positive Interpersonal Relations in Small Groups:" In J. Berger, M. Zelditch Jr. and B. Anderson (Eds.),. *Sociological Theories in Progress*.

Department of Transport Environment and the Regions, D. (1998). *Sustainable Local Communities for the 21st Century (DTER).*

Devinney, T. M. (2009). Is the socially responsible corporation a myth? The good, the bad, and the ugly of corporate social responsibility. *Acad. Manage. Perspect.*, *23*(2), 44–56.

E. Innes, J., & Booher, D. E. (2000). Indicators for sustainable communities: a strategy building on complexity theory and distributed intelligence. *Planning Theory & Practice*, *1*(2), 173–186.

Eninger, C.; Zambetakis, E. (2009). The Geopolitics of Arctic Melt. *International A Airs*, *85*(6), 1215–1232.

Faury, O., Cariou, P. (2016). The Northern Sea Route competitiveness for oil tankers. *Transportation Research Part A: Policy and Practice*, *94*, 461–469.

Giannakis, M., & Papadopoulos, T. (2016). Supply chain sustainability: A risk management approach. *International Journal of Production Economics*, *171*, 455–470. https://doi.org/10.1016/j.ijpe.2015.06.032

Gimeno, J., & Woo, C. Y. (1999). Multimarket Contact, Economies of Scale, and Firm Performance. *The Academy of Management Journal*, *42*(3), 239–259. https://doi.org/10.2307/256917

Gray, D. (2004). Doing research in the real world. London: Thousand Oaks.

Griffith, D. ., Harvey, M. G., & Lusch., R. F. (2006). Social Exchange in Supply Chain Relationships: TheResulting Benefits of Procedural and Distributive Justice. *Journal of Operations Management*, *24*(2), 85–98.

Halliday, W., Insley, S., Hilliard, R., De Jong, T., Pine, M. (2017). Potential impacts of shipping noise on marine mammals in the western Canadian Arctic. *Marine Pollution Bulletin*.

Hummon, N. P., & Doreian., P. (2003). "Some Dynamics of Social Balance Processes: Bringing Heider Back into Balance Theory. *Social Networks*, *25*, 17–49.

Husted, B., & de Jesus Salazar, J. W. (2006). Taking Friedman seriously: maximizing profits and social performance. *J. Manage. Stud.*, *43*(1), 75–91.

Huxham, C., & Vangen, S. (1996). Working together: Key themes in the management of relationships between public and non-profit organizations. *International Journal of Public Sector Management*, *9*(7), 5–17.

International Maritime Organization. (2015). The Polar Code. Retrieved from http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx

Jabour, J. (2014). Arctic opening: insecurity and opportunity. *The Polar Journal*, *4*(1), 229–231.

Juttner, U., Peck, H., & Christopher, M. G. (2003). Supply Chain Risk Management: Outlining an Agenda for Future Research. *International Journal of Logistics: Research and Applications*, *6*(4), 197–210.

Kaiser, B.A., Fernandez, L.M. and Vestergaard, N. (2016). The future of the marine Arctic: environmental and resource economic development issues. *The Polar Journal*, *6*(1), 152–168.

Kapucu, N. (2012). Disaster resilience and adaptive capacity in Central Florida, US, and in Eastern Marmara Region, Turkey. J. Comp. *Policy Anal.: Res. Pract.*, *14*(3), 202–216.

Kiiski, T., Solakivi, T., Töyli, J. and Ojala, L. (2016). Long-term dynamics of shipping and icebreaker capacity along the Northern Sea Route. *Maritime Economics & Logistics, 1*(25).

Kitagawa, H. (2008). Arctic Routing: Challenges and Opportunities. *WMU Journal of Maritime Affairs, 7*, 485–503.

Kives, B. (2017). Churchill marks dour milestone a year after layoffs at its port. *CBC News*.

Klijn, E.-H., & Teisman, G. R. (2013). 'Institutional and Strategic Barriers to Public-Private Partnerships: an Analysis of Dutch Cases.' *Public Money and Management*, *23*(3), 137–146.

Kumaraswamy, M. M., Zou, W. W., & Zhang, J. Q. (2015). Reinforcing relationships for resilience – by embedding end-user people' in public private partnerships. *Journal of Civil Engineering and Environmental Systems*, *32*(Nos 1/2), 119–129. https://doi.org/10.1080/10286608.2015.1022727

Larsen, J. N. (2016). Polar economics: expectations and real economic futures. *The Polar Journal*, *6*(1), 1–10.

Lasserre, F., Beveridge, L., Fournier, M., Têtu, P. L., Huang, L. (2016). Polar seaways? Maritime transport in the Arctic: An analysis of shipowners' intentions II. *Journal of Transport Geography*, *57*, 105–114.

Lasserre, F., Pelletier, S. (2011). Polar super seaways? Maritime transport in the Arctic: an analysis of shipowners' intentions. *Journal of Transport Geography*, *19*, 1465–1473.

Lasserre, F. (2011). Arctic shipping routes. *International Journal*, *66*(4), 793–808. Retrieved from http://search.proquest.com/docview/920587547?accountid=14732%5Cnhttp://bd9jx6as9l.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rfr_id=info:sid/ProQ:politicalscience&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&

Lasserre, F. (2014). Case studies of shipping along Arctic routes. Analysis and profitability perspectives for the container sector. *Transportation Research Part A: Policy and Practice*, *66*, 144–161.

Lee, T., & Kim, H. J. (2015). Barriers of voyaging on the Northern Sea Route: A perspective from shipping Companies. *Marine Policy*, *62*, 264–270. https://doi.org/10.1016/j.marpol.2015.09.006

Liu, M., Kronbak, J. (2010). The potential economic viability of using the Northern Sea Route (NSR) as an alternative route between Asia and Europe. *Journal of Transport Geography*, *18*, 434–444.

Madhavan, R., D.R., G., & He., J. (2004). "Two's Company, Three's a Crowd? Triads in Cooperative- Competitive Networks;" Academy of Management Journal, (47:6), 2004, pp. ., 918–927.

Madhavan, R., Gnyawali, D. R., & Jinyu, H. E. (2004). Two's company, three's a crowd? Triads in cooperative-competitive networks. *Academy of Management Journal*, *47*(6), 918–927.

Marques, J. C., & Mintzberg, H. (2015). Why corporate social responsibility isn't a piece of cake. *MIT Sloan Manage. Rev.*, *56*(4), 8.

Marsden, T. (Ed.). (2008). *Sustainable communities*. Emerald Group Publishing.

Mauthner, N. S., & Doucet, A. (2003). Reflexive Accounts and Accounts of Reflexivity in Qualitative Data Analysis. *Sociology*, *37*(3), 413–431. https://doi.org/10.1177/00380385030373002

McConnell, A., & Drennan, L. (2006). Mission impossible? Planning and preparing for crisis. *J. Contingencies Crisis Manage.*, *14*(2), 59–70.

McKinnon, A. (2006). Life without trucks: the impact of a temporary disruption of road freight transport on a national economy. *Journal of Business Logistics*, *27*(2), 227–250.

Melia, N., Haines, K., Hawkins, E., Day, J. J. (2017). Towards seasonal Arctic shipping route predictions. *Environmental Research Letters*, *12*(8).

Meng, Q., Zhang, Y. and Xu, M. (2016). Viability of transarctic shipping routes: a literature review from the navigational and commercial perspectives. *Maritime Policy & Management*, 1–26.

Miller, A. W.; Ruiz, G. M. (2014). Arctic shipping and marine invaders. *Nature Climate Change*, *4*(6), 413–416.

Monge, P. R., & Contractor., N. S. (2001). *"Emergence of Communication Networks:'' In EM. Jablin and L.L. Putman (Eds.), Handbook of Organizational Communication."* ,*Sage, Beverly Hills, CA*, ,.

Morgan, R. M., & Hunt., S. D. (1994). 'The Commitment-Trust Theory of Relationship Marketing. *Journal of Marketing*, *58*(3), 20–38.

Morrissette, J. 0. (1958). An Experimental Study of the Theory of Structural Balance. *Human Relations*, *11*, 239–254.

Nemry, F., & Demirel, H. (2012). *Impacts of Climate Change on Transport: A focus on road and rail transport infrastructures.*

Newcomb, T., & Heider, F. (1958). *The Psychology of Interpersonal Relations. American Sociological Review* (Vol. 23). New York. https://doi.org/10.2307/2089062

Ng, A.K.Y., Becker, A., Cahoon, S., Chen, S.L., Earl, P. and Yang, Z. (2016). *Climate Change and Adaptation Planning for Ports*. Routledge, Abingdon.

Ng, A.K.Y. and Liu, J. . (2014). *Port-Focal Logistics and Global Supply Chains*. algrave Macmillan, Basingstoke.

Ng, & S. (2010). The environmental impacts of pollutants generated by routine shipping operations on ports. *Ocean and Coastal Management*, *53*(5), 301–311.

Ng, A. K., Andrews, J., Babb, D., Lin, Y., & Becker, A. (2018). Implications of climate change for shipping: Opening the Arctic seas. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(2), E507.

Ostreng, W., Eger, K. M., Fløistad, B., Jørgensen-Dahl, A. Lothe, L., & Mejlænder-Larsen, M. Wergeland, T. (2013). *Shipping in Arctic waters: a comparison of the Northeast, Northwest and trans polar passages. Springer Science & Business Media.*

Paskaleva, K. (2015). *'E-governance as an enabler of the smart city, In Deakin, M. (ed.). Smart cities. Governing, modelling and analising the transition*. Routledge, Oxfordshire.

Peck, H. (2005). The Drivers of Supply Chain Vulnerability: An Integrated Framework. *International Journal of Physical Distribution and Logistics Management*, *35*(4), 210–232.

Perjo, L., Fredricsson, C., & Costa, S. O. (2016). *Public-Private-People Partnership in Urban Planning*.

Pierre, C. and Olivier, F. (2015). Relevance of the Northern Sea Route (NSR) for bulk shipping. *Transportation Research Part A: Policy and Practice*, *78*, 337–346.

Powell, R. (2014). *Polar Geopolitics: Knowledges, Resources and Legal Regimes.*

Rich, R. C., Edelstein, M., Hallman, W. K., & Wandersman, A. H. (1995). Citizen participation and emprowerment: The case of local environmental hazards. *American Journal of Community Psychology*, *23*(5), 657–676.

Robertson, D. (2017). Churchill dying,' business leader says, vowing blockade if Via tries to ship rail cars south by barge.

Rodrigues, A. (1983). Effects of Balance, Positivity, and Agree- ment in Triadic Social Relations:' Journal of Person- ality and Social Psychology, (5:4), 1967, pp. 472-476. Rodrigues, A. and J.A.D. Coleta. 'The Prediction of Preferences for Triadic Relations. *Journal of Social Psychology*, *121*(1), 73–80.

Rodrigues, A., & Coleta., J. A. D. (1983). The Prediction of Preferences for Triadic Relations. *Journal of Social Psychology*, *121*(1), 73–80.

Roh, H. S. (2011). *Effects of opening NSR on the emergence of regional port-industry clusters'. Paper presented at the International Conference on Opening Northern Sea Route and Dynamic Changes in the North Pacific Logistics and Resource Security*. Honolulu, US.

Roseland, M. (1998). *Toward Sustainable Communities: Resources for Citizens and their Governments*. Gabriola Island, BC, New Society Publishers.

Saleem, S., Kumar, A., & Shahid, A. (2016). Arguments against corporate social responsibility. *Imperial J. Interdisciplinary Res.*, *2*(8).

Schauppenlehner-Kloyber, E., & Penker, M. (2016). Between participation and collective action—from occasional liaisons towards long-term co-management for urban resilience. *Sustainability*, *8*(7), 664.

Schøyen, H., Bråthen, S. (2011). The Northern Sea Route versus the Suez Canal: cases from bulk shipping. *Journal of Transport Geography*, *19*, 977–983.

Schøyen, H. Bråthen, S. (2011). The Northern Sea Route versus the Suez Canal: cases from bulk shipping. *Journal of Transport Geography*, *19*, 977–983.

Shinozuka, M., Rose, A., & Eguchi, R. T. (1998). *Engineering and socioeconomic impacts of earthquakes*.

Somanathan, S., Flynn, P. C., Szymanski, J. K. (2007). Feasibility of a Sea Route through the Canadian Arctic. *Maritime Economics & Logistics*, *9*, 324–334.

Svensson, G. (2000). Conceptual Framework for the Analysis of Vulnerability in Supply Chains. *International Journal of Physical Distribution and Logistics Management*, *30*(9), 731–749.

Tatano, H., & Tsuchiya, S. (2008). A framework for economic loss estimation due to seismic transportation network disruption: a spatial computable general equilibrium approach. *Natural Hazards*, *44*(2), 253–265. https://doi.org/10.1007/s11069-007-9151-0

Taylor, H. F. (1967). Balance and Change in the Two-Person Group. *Sociometry*, *30*(3), 262–279.

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, *16*(10), 837–851.

UNFCCC. (2014). Focus: adaptation. Retrieved from http://unfccc.int/focus/adaptation/items/6999.php

United Nations, E., S. C. (2007). *Participatory governance and citizen's engagement in policy development, service delivery and budgeting*.

Uzzi, B. (1997). Social Structure and Competition in Inter- firm Networks: The Paradox of Embeddedness. *Administrative Sdence Quarterly*, *42*(1), 35–67.

World Commission on Environment and Development. (1987). *Our Common Future*.

Xu, H., Yin, Z., Jia, D., Jin, F., & Ouyang, H. (2011). The potential seasonal alternative of Asia–Europe container service via Northern sea route under the Arctic sea ice retreat. *Maritime Policy & Management*, *38*(5), 541–560. https://doi.org/10.1080/03088839.2011.597449

Yin, R. K. (2009). *Case Study Researc Design and Methods Fourth Edition*. *Applied Social Research Methods Seiries* (Vol. 5).

Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, *9*.

Zhang, Y., Meng, Q., Zhang, L. (2016). Is the Northern Sea Route attractive to shipping companies? Some insights from recent ship traffic data. *Marine Policy*, *73*, 53–60.

Zhao, H., Hu, H., Lin, Y. (2016). Study on China-EU container shipping network in the context of Northern Sea Route. *Journal of Transport Geography*, *53*, 50–60.

APPENDIX A- INTERVIEW QUESTIONS

Part A: The Impacts of Transportation Disruption

A1. In general, what is the influence of the Railway Disruption? (e.g., price, employment, tourism, commuting cost, etc.)

A2. In your opinion, how does the breakdown of railway bring such severe consequence to the local community and surrounding communities?

Part B: The nature, organization, and stakeholders involved in local transportation system to adapt to the disruption

B1. For the local transportation system, Omnitrax operated both the port and railway. What do you believe that such similarity/difference in this organization compared with the public organization?

B3. Given the 'public serving' nature of local transportation system, do you think the system should include any non-government organizations like First Nation in the process (either in a consultation or actual day-to-day involvement in preparation of the planning document)? For example, is it a highly 'public participatory' process, a highly neo-liberal (emphasize on 'economic growth first') process, or highly top-down approach?

Part C: Perspective of potential solutions or opportunities (e.g., Arctic Shipping) to Local community

C1. In your opinion, what are the potential implications of Churchill port and railway if they get fixed or even upgraded shortly?